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JUNE 1935

VOLUME VI NUMBER X

A MAGAZINE OF METHODS FOR OPERATING MEN

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Meetings

American Society of Chemical Engineers—June 19, 20, and 21, Cincinnati, Ohio.

Pennsylvania Grade Crude Oil Association, Annual Meeting—June 20 and 21, State College, Pennsylvania.

American Society for Testing Materials, Annual Meeting—June 24, 25, 26, 27 and 28, Book Cadillac Hotel, Detroit, Michigan.

California Natural Gasoline Association—July 4, Richfield Building, Los Angeles.

American Chemical Society—August 19, 20, 21, 22, 23, and 24, San Francisco, California.

American Institute of Mining and Metallurgical Engineers, Petroleum Division of Mid-Continent Section—October 10, 11, and 12, Houston, Texas.

American Gas Association, Manufacturers' Division—October 14, 15, 16, 17, and 18, Atlantic City, New Jersey.

American Association of Petroleum Geologists, Mid-Year Meeting—October 16 and 17, Mexico City, Mexico.

American Association of Petroleum Geologists, San Antonio Section (San Antonio Geological Society, Seventh Annual Meeting)—October 16 and 17, Mexico City, Mexico.

Independent Petroleum Association of America, Annual Meeting—November 4 and 5, Adolphus and Baker Hotels, Dallas, Texas.

American Petroleum Institute, Sixteenth Annual Meeting—November 11, 12, 13, and 14, Biltmore Hotel, Los Angeles, California.

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The Course of Oil

By K. C. SCLATER

Appropriations for Research Restored

Increased appropriations have been granted to the Petroleum and Natural Gas Division of the U. S. Bureau of Mines for the fiscal year 1936, which begins July 1.

In the fiscal year 1931, the total appropriation to the U. S. Bureau of Mines was $2,549,000, of which $234,000 was for oil and gas investigations. In 1932 the corresponding figures were $2,278,000 and $232,860, respectively. Then drastic cuts in appropriations began to be made and for 1935 the total appropriation to the Bureau of Mines was only about $1,200,000, of which $117,000 was for oil and gas investigations. This amount is approximately half that granted for the fiscal year 1932 and indicates how seriously the work of carrying on vital investigations in oil and gas has been crippled.

For the fiscal year 1936 the total appropriation to the Bureau of Mines was increased to $1,970,311. Of this sum, $237,866 is for oil and gas investigations. With this amount, which is approximately equal to the 1932 appropriation, it is hoped to accomplish much.

Every effort is now being bent by the Petroleum and Natural Gas Division of the Bureau of Mines in making plans to assure that the money will be spent wisely to the benefit of the industry, the nation, and the general public.

Investigations that were under way in 1932 and had to be dropped when appropriations were drastically reduced will be resumed, but it will take some time to begin where the work was left off. Personnel and equipment will have to be brought together and arrangement made to carry on the investigations in the light of the most recent developments and practices that have taken place in the three-year interval. Much groundwork will have to be done to bring technological information up to date before a thorough beginning can be made on the actual laboratory and field studies in oil and gas.

Referring to the expansion of activities, the Bureau of Mines at Washington states:

"Factual information with respect to production, storage and utilization of petroleum and natural gas is in greater need by the Government and the industry today than ever before. Reserves of these natural resources are limited and substitutes can be had only at high cost, so it is important that petroleum shall be produced without waste, as needed, and that as little oil as possible shall be left underground beyond recovery." In order to accomplish those ends, "exact engineering information is needed concerning conditions in underground reservoirs and wells, and of the physical laws governing the flow of oil. New plans of proration, production control, and coöperative development of newly discovered structures are full of technical difficulties. Adequate studies to obtain the needed engineering information can be made only by an experienced and impartial organization such as the Bureau of Mines. The additional funds for the coming year will enable the Bureau to resume its activities in this field where its studies in the past have invariably been reflected in reduced costs, increased safety and efficiency, and wise conservation of resources."

Sound Practices Recognized by Court

An opinion has been handed down by the Texas Supreme Court that takes full cognizance of engineering progress in oilfield exploitation methods and marks a definite breaking away from the old law-of-capture theory.

While the court recognizes that it is impossible to measure the exact quantity of gas and oil beneath each tract of land and that it is equally impossible to fix a standard that will give exact justice to all landowners, the court does state that: "It is now, however, recognized that when an oilfield has been fairly tested and developed, experts can determine approximately the amount of oil and gas in place in a common pool, and can also equitably determine the amount of oil and gas recoverable by the owner of each tract of land under certain operating conditions."

In effect, the opinion of the court is that each operator should be entitled to recover a quantity of oil and gas substantially equivalent in amount to the recoverable oil and gas under his land.

It would seem that acreage must inevitably be considered in allocating allowable production. It is this very fact that is causing concern because of its possible far-reaching effect—at least, so far as it applies to Texas, and in particular to the East Texas field.

It may mean that the well with a twenty-acre spacing will be allowed to produce twice that of a well with a ten-acre spacing, or four times that of a well with a five-acre spacing.

According to the marginal well law, no well in the East Texas field can be limited to less than twenty barrels a day. In that case, the allowable production for wells with a wide spacing may have to be revised upward to conform with the opinion of the State Supreme Court. This would result in a daily allowable production for the field much greater than at present, and probably so high as to be beyond what has already been established as preventing physical waste. If such were the case, it may force a revision of the marginal well law, unless it can be shown that the limit for a marginal well is not based on any arbitrary considerations—which will be difficult to do.

Whatever the outcome of the handing down of this opinion by the Texas Supreme Court, it is becoming increasingly evident that regulations, if they are to survive, governing the development and production of oilfields, must be based on sound engineering practices that insure each operator his just share of the oil, gas, and gas energy.

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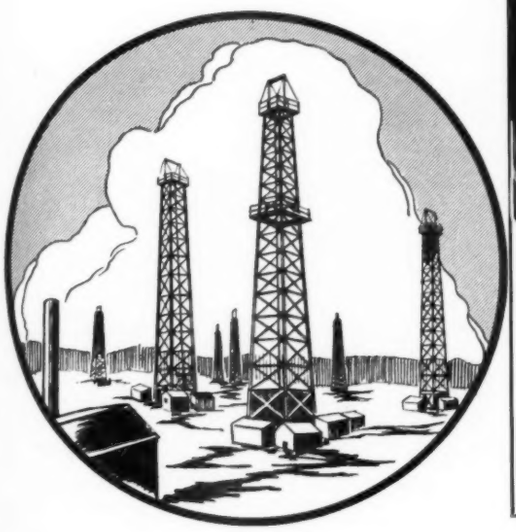

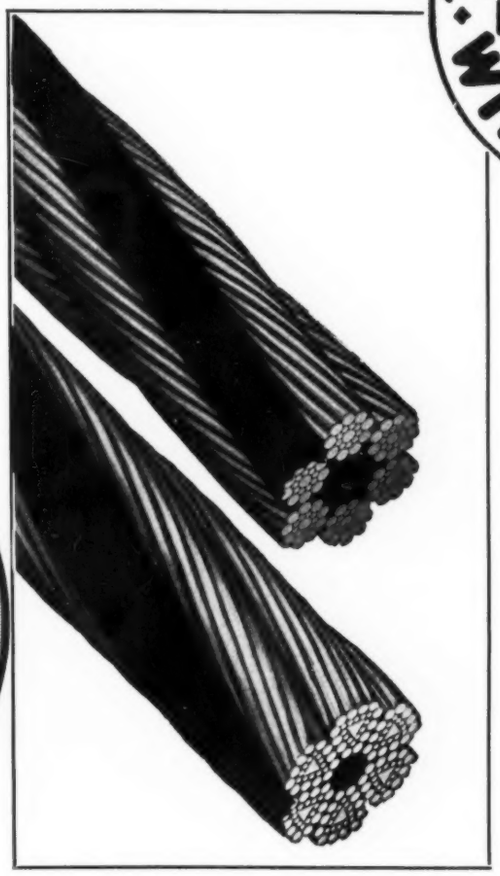

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« « « HIGHLIGHTS IN OILDOM » » »

NRA Held Invalid By High Court

The National Industrial Recovery Act has been declared invalid by the United States Supreme Court. The decision, of course, eliminates the oil code, as well as all codes under the N. R. A. In making its decision the high court termed the recovery act an unconstitutional delegation of legislative authority to the President and an encroachment upon the rights of the individual states. It was pointed out that any industry whose activities but indirectly affected interstate commerce was subject only to state regulation.

Commenting upon the delegation of legislative authority to the President, the court stated:

"The Congress is not permitted to abdicate or to transfer to others the essential legislative functions with which it is thus vested. We have repeatedly recognized the necessity of adapting legislation to complex conditions involving a host of details with which the national legislature cannot deal directly. We pointed out in the Panama case that the constitution has never been regarded as denying to Congress the necessary resources of flexibility and practicality which will enable it to perform its functions in laying down policies and establishing standards, while leaving to selected instrumentalities the making of subordinate rules within prescribed limits and the determination of facts to which the policy as declared by the legislature is to apply. But we said that the constant recognition of the necessity and validity of such provisions and the wide range of administrative authority which has been developed by means of them cannot be allowed to obscure the limitations of the authority to delegate."

The government had contended that the law was justified because of the existence of a "grave national crisis." In answering this contention, the Supreme Court said that "extraordinary conditions do not create or enlarge constitutional power."

●

Abandon World's Deepest Test at 12,786 Ft.

After being drilled to a total depth of 12,786 ft., the Gulf Production Company's No. 103 J. T. McElroy, in Upton County, Texas, has been ordered abandoned. Drilling ceased in the Ellenberger limestone. This constitutes the world's deepest test, surpassing the General Petroleum Corporation's No. 1 Berry in the Belridge field, California, by 1,409 feet.

Before the hole is plugged the Gulf's geophysical and geological staff will make a series of tests. Several horizons in the lower Pennsylvanian and Ordovician sections also may be tested for production, although the possibility of their success is not considered great.

In drilling the test to such great depth much valuable data have been obtained, and several drilling records broken. Almost a year ago a string of 7⅝-in. casing was landed at 10,301 ft., the longest string of pipe ever to be successfully run and cemented. Of interest also was the fact that, although it required two years, two months, and four days, to drill the test, no lost-time accidents occurred, and there were no major fishing jobs or other operating difficulties.

Calif. Takes Action After Scrapping of Code

Scrapping of the oil code by the Supreme Court decision was of particular significance to California operators, as that state has no legislation governing the oil industry. For several months efforts have been made to obtain an oil proration law in the state; however, chances of passing such a bill during the present session of the legislature now seem remote.

To alleviate the situation the central committee of the California Oil Producers Agency has taken action. That body, which was the official curtailment committee under the petroleum code, met following the Supreme Court decision and voted to empower J. R. Pemberton, state oil umpire, Ralph B. Lloyd, and a subcommittee to allocate a daily allowable of 512,700 bbl. during June. This is a temporary program and conformity on the part of operators is entirely voluntary.

●

Serious Test for Eastern Fields Declared at Hand

Speaking before the American Petroleum Institute at Pittsburgh recently, John C. Askam, of Findlay, Ohio, engineer for the Ohio Oil Company, said that oil wells in the eastern fields are at a low ebb and engineering technique must be utilized if these decreasing pools are to be operated efficiently and profitably. Eastern fields have gone through many life-and-death trials, but the most serious test is now at hand, he stated, and continued:

"Forty or fifty years ago the orders were to drill wells and get oil up from the bowels of the earth. This policy was followed to the letter, and today we find ourselves in a turmoil as to past records, costs, and other productive data." He paid tribute to the old-timers, however, by saying that they had developed a time-tried technique of production and many of the achievements of their trial-and-error methods should be studied by every practical oil man today.

Declaring that it is "good horse sense to curb overproduction and not dissipate natural resources that have required thousands of years to form," he added that up-to-date methods can do exactly that.

●

Interesting Decision in Pipe Line Case

In the case of Nazworthy vs. the Illinois Pipe Line Company the United States Supreme Court has ruled that pipe line companies must pay property owners adjacent to rural highways when a line is laid in the road. The case originated at Okemah, Oklahoma, being taken to the Supreme Court after trials in the lower courts.

The defense contended that a pipe line is a means of transportation the same as trucks, therefore should have the use of roads. The court held, however, that the laying of a pipe line in the road constitutes an added servitude on the soil, entitling the adjacent landowner to compensation.

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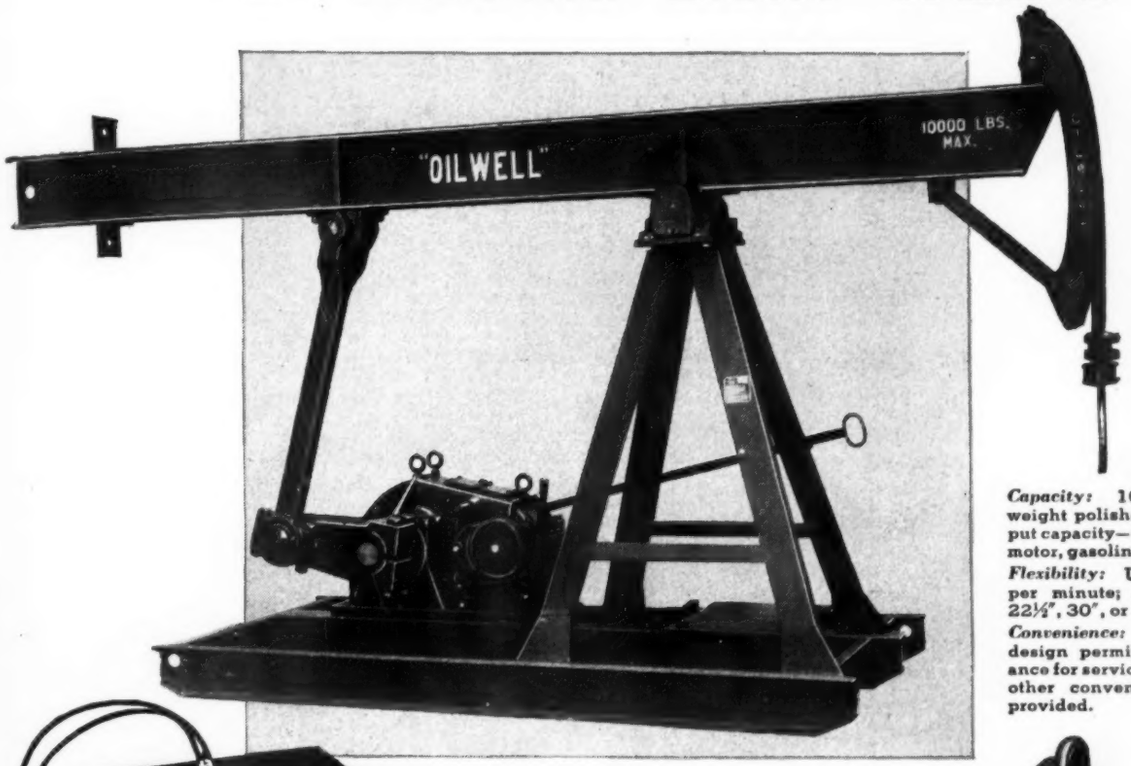

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LATEST ACTIVITIES IN THE OIL FIELDS

AN oil strike eight miles south of Medicine Bow, Wyoming, is being looked upon as the most important development in the Rocky Mountain area since the discovery of oil at Salt Creek in 1914. The well, Kyle No. 1 of the Ohio Oil Company and The California Company, was completed June 7, making 6360 bbl. of 63 gravity crude daily and 81,000,000 cu. ft. of gas. This is said to be the largest development of such high gravity crude in the history of petroleum. Gas production is from the first Sundance sand at a depth of 5151-5222 ft., and oil production from the second Sundance at 5299-5394 feet.

•

A new pool was opened in Barton County, Kansas, when Harry Downing and others' No. 1 Eberhart was drilled to a total depth of 3360 ft. in the Siliceous lime and filled up 2500 ft. with oil. The well is northeast of Ellinwood.

•

With the bringing in recently of The Texas Company's No. 1 St. Denis, the Louisiana Gulf Coast was given a new pool. The well not only is the first in Jefferson Parish, but also has the distinction of being the deepest producer on the Gulf Coast. It was completed at a total depth of 9572 ft. in the Miocene sand. Initial production was 2400 bbl. of 34.9 gravity oil per day through three-eighths in. choke.

•

The Eunice field of New Mexico has been extended nearly three miles to the southeast by the Ohio Oil Company's State-McDonald No. 3, which, on the initial flow test, produced 250 bbl. of oil per hour. The well is drilled to a total depth of 3816 feet.

•

The Potter County, Pennsylvania, gas field has been given an extension by Potter Development Company's No. 1 McAllister. The well, drilled to 5115 ft., gauged 3,400,000 cu. ft., with rock pressure of 2115 pounds.

A new field, named the Loma Alto field, was discovered May 29 in the extreme southern part of McMullen County, Texas. The discovery well is the Texio Oil Company's and the Illinois Oil Coompany's No. 1 Atkinson. Production is from a depth of 2195-2207 feet. When brought in the well started flowing by heads, making 25 bbl. per hour through ¼-in. choke. After two hours it went dead, but was revived and flowed an average of ten bbl. per hour through ⅛-in. choke. The oil is of 23 gravity.

•

The Gulf Production Company's No. 1 Mrs. C. A. Goldsmith in Ector County, Texas, five and one-half miles southwest of the Cowden field, is considered of major importance. At a depth of 4170-4172 ft. it made 25 bbl. of oil an hour, together with 2,500,000 cu. ft. of gas, on the initial test. The oil is almost sweet and grades 36.2 gravity, the highest in the county.

•

A second oil field in the Oklahoma City area was indicated when No. 1 Owens of Slick-Urschel, et al., two miles northwest of Britton, Oklahoma, blew in while the crew was bailing the hole down after finding showings in both the Wilcox sand and the lime immediately below. It was shut in after making from 1,500,000 to 3,000,000 cu. ft. of gas and a head of oil. Opened later it made several flows of oil and mud and bridged in the pipe. Later still a core was taken from 6765-6767 ft. with a showing of both oil and gas.

•

Another gas field in Kern County, California, appears probable. At Kernell the Standard Oil Company's No. 1 Widgeon, drilled to 3256 ft., showed for 6,760,000 cu. ft. of gas, with some water.

•

Oil production in the Cut Bank, Montana, field was extended a half mile east into the gas area by the Montana Headlight's No. 5 Yunck. The well, drilled to a total depth of 2,810 ft., flowed 92 bbl. daily on the initial test.

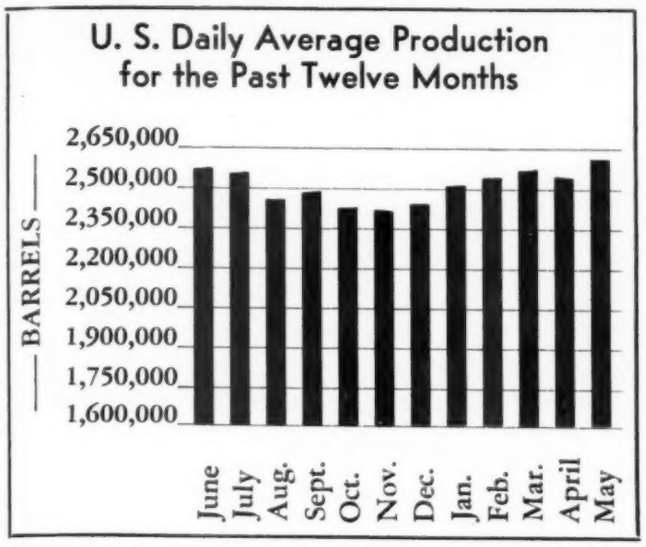
AVERAGE CRUDE OIL PRICES

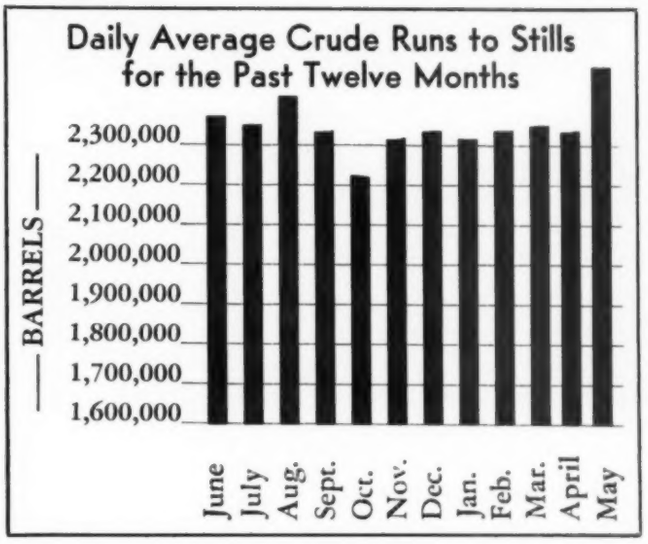
California		Louisiana	
Playa Del Rey	$ .90	North Louisiana	$ .95
Coalinga	.81	Gulf Coast	1.04
Signal Hill	1.12	Illinois	1.13
Montana	1.35	Kentucky	1.13
Wyoming	1.00	Indiana	1.12
Colorado	1.00	Ohio	
New Mexico	.75	Lima	1.30
Texas		Michigan	1.02
North Central	.95	Pennsylvania	
Panhandle	.51-.71	Bradford	2.20
West Texas	.70-.75	Southwest	1.92
Gulf Coast	1.04	Eureka	1.87
Darst Creek	.87	Buckeye	1.77
East Texas	1.00	Corning	1.32
Kansas	1.00	West Virginia	1.67
Oklahoma	1.00	Canada	2.10-2.17
Arkansas	.70		

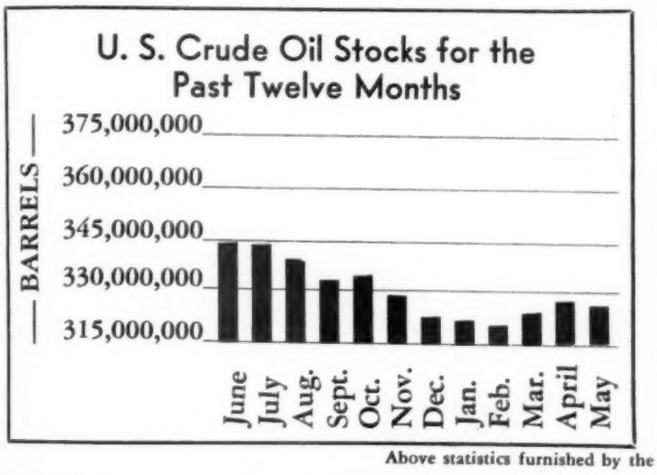
DAILY AVERAGE CRUDE OIL PRODUCTION
Furnished by A.P.I.

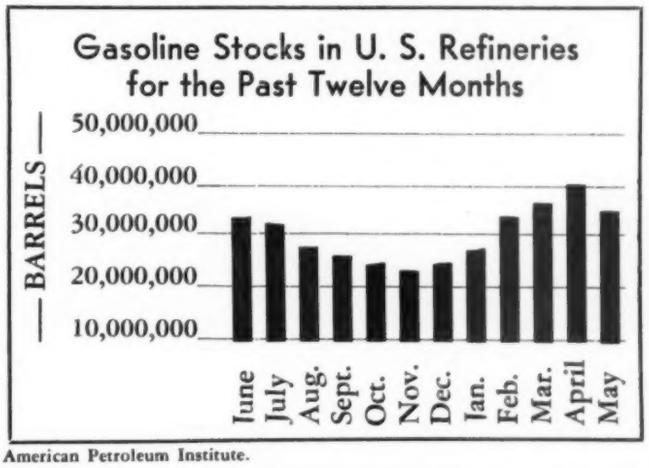
(Figures in barrels)

	Federal Agency Allowable Effective May 1	Week Ended June 1, 1935	Week Ended April 27, 1935	Week Ended June 2, 1934
Oklahoma	500,200	494,800	522,750	476,950
Kansas	148,400	153,200	146,000	132,150
Panhandle Texas		62,550	61,650	59,150
North Texas		58,800	58,450	56,100
West Central Texas		25,750	23,300	27,100
West Texas		151,100	152,950	143,650
East Central Texas		47,400	48,800	51,350
East Texas		453,000	443,600	478,550
Conroe		41,600	43,300	55,500
Southwest Texas		59,050	62,400	47,700
Coastal Texas (Not incl. Conroe)		136,850	138,100	116,750
TOTAL TEXAS	1,032,900	1,036,100	1,032,550	1,035,850
North Louisiana		23,200	22,900	25,300
Coastal Louisiana		115,950	101,450	64,100
TOTAL LOUISIANA	112,200	139,150	124,350	89,400
Arkansas	30,300	31,200	30,200	30,900
Eastern (Not incl. Michigan)	106,200	109,600	108,450	103,900
Michigan	34,300	40,350	40,900	34,750
Wyoming	36,100	35,150	33,100	32,850
Montana	11,000	10,250	10,450	7,900
Colorado	3,900	3,900	5,000	2,850
TOTAL RK. MT. ST.	51,000	49,300	48,550	43,600
New Mexico	51,500	51,000	50,350	45,900
California	494,200	471,200	457,300	460,000
TOTAL U. S.	2,561,200	2,575,900	2,561,400	2,453,400









Above statistics furnished by the American Petroleum Institute.

Summarized Operations in Active Fields for May, 1935

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
TEXAS								
East Texas	418	408	118	241	3600	2	40	Rotary
Duval County	33	25	5	4	2300	2	22	Rotary
Archer County	77	49	27	46	660–1800	1 or 2	40	Rot.-Cab.
Conroe	8	6	2	6	2000–7400	3 or 4	40	Rotary
Refugio County	5	5	1	6	5200	2	38	Rotary
OKLAHOMA								
Oklahoma City	7	3	12	30	6500	3	39	Rotary
Pontotoc County	36	35	13	65	1800–4488	2 or 3	38	Rotary
Osage County	30	23	23	51	380–2850	2	37.5–40	Rot.-Cab.
KANSAS								
McPherson County	10	5	4	24	2900–4300	2	38	Rot.-Cab.
Harvey County	7	3	5	9	3450	2 or 4	37	Rot.-Cab.
Ellsworth Arch	75	55	33	124	3300	4	37	Rot.-Cab.
CALIFORNIA								
Kettleman Hills	1	1	1	25	8300	3 or 4	40	Rotary
Long Beach	14	14	18	43	7000	3	36	Rotary

Field Activities by States for May, 1935

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1934 (In Barrels)
	May	April	May	April	May	April	May	April	May	April	
Arkansas	16	11	8	2	7	7	10	10	38	44	11,412,100
California	76	55	65	52	98	77	130	87	283	224	175,678,362
Colorado	2	....	2	....	....	....	3	2	27	30	1,168,000
Illinois	....	1	....	0	....	....	1	13	7	10	4,466,000
Indiana	30	12	14	8	....	....	3	2	33	35	813,000
Kansas	139	124	92	100	106	83	46	40	195	191	45,577,050
Kentucky	18	20	15	19	....	....	1	5	11	12	4,863,000
Louisiana	48	72	33	45	81	92	55	39	158	153	32,572,900
Michigan	47	35	32	22	78	38	143	119	157	137	10,589,600
Mississippi	2	1	1	1	....	....	3	2	15	14	Gas. Prod.
Montana	4	9	4	8	....	....	15	12	51	48	3,797,000
New Mexico	26	22	16	19	....	....	29	22	85	96	16,529,050
New York	....	....	....	....	....	....	1	3	0	2	3,880,700
Ohio	103	101	69	73	....	....	66	57	194	193	4,291,000
Oklahoma	249	166	156	117	191	220	86	93	407	498	176,506,550
Pennsylvania	7	20	4	16	....	....	24	32	130	82	15,353,850
Texas	984	1051	757	791	1024	1053	420	352	1129	907	380,848,000
West Virginia	39	21	32	18	....	....	22	19	77	67	4,043,550
Wyoming	5	5	4	3	....	....	9	5	67	68	12,371,100
Total	1795	1727	1304	1296	1585	1570	1067	902	3064	2809	903,350,812

PROGRESS OF MAJOR PIPE LINE WORK

OFFICIALS of the Lone Star Gas Company have announced definitely that construction of a 20-in. welded line from Irving Junction, near Dallas, to the Cayuga and Long Lake gas fields in Anderson County, Texas, a distance of approximately 114 miles, will start August 1. That the line would be laid had been announced previously, this being the first indication, however, of when work actually would start. The project is expected to be completed by November 15.

The line will have a maximum capacity of 125,000,000 cu. ft. of gas daily. Since gas wells in the Cayuga field average 1500 lb. rock pressure, and those in the Long Lake field 2100 lb., the line will be operated entirely on well pressure. The Lone Star Gas Company has obtained a 20-year gas purchasing contract from the Tide Water Oil Company and the Texas Seaboard Oil Company, principal operators in the Cayuga field, and they already have gas purchasing contracts with the same companies, as well as with H. L. Hunt, covering production in the Long Lake field.

●

An 85-mile 6-in. oil line is to be laid from the Sam Fordyce field in Hidalgo County, Texas, to terminals at Port Isabel and Brownsville on the Gulf coast. The Cortez Pipe Line Company, associate company of the Cortez Oil Company, of which B. F. Weekly of Fort Worth is president, will construct the line. Associated with the Cortez Pipe Line Company in the project will be Edgar H. Stapper and Company of New York City, and O. R. Seagraves of Houston, Texas. It is expected that the line will be completed some time in August.

The Cortez Oil Company will start laying a gathering line immediately and will erect an 80,000-bbl. tank in the field for storage of crude until the trunk line is completed. One pump station will be built, that to be in the field, with a daily capacity of 8000 bbl. A second station will be erected later if needed.

The Sam Fordyce field has approximately 65 wells and since the Crown Central stopped buying crude in Hidalgo County operators have experienced some difficulty in getting adequate outlets. The Barnsdall and Woods line is not large enough to handle all the oil produced.

●

Ralph E. Fair and associates of Dallas, Texas, also have announced their intention of constructing a 6-in. oil line from the Sam Fordyce field in Hidalgo County, Texas, to the Port Isabel-Brownsville, district, a distance of 85 miles. It also has been announced by Fair and his associates that they have completed a contract with the Sun Oil Company for its Cuevitas field production in northern Starr County and will lay a 22-mile, 4-in. pipe line to Rio Grande City, where crude will be loaded into tank cars for shipment by rail.

●

Extension of the Keystone Pipe Line Company's gasoline line from a point near Harrisburg, Pennsylvania, to Pittsburgh, a distance of 180 miles, has been announced. It will be an 8-in. line and the contract for its construction has been awarded to the Mitchell-Stewart Construction Company of Dallas, Texas. The capacity of the line will be approximately 20,000 bbl. of gasoline daily. The Keystone Pipe Line Company is a subsidiary of the Atlantic Refining Company.

●

The 12-in., 17-mile gas line being laid by the United Gas Public Service Company from the Rodessa gas field in northwest Caddo Parish, Louisiana, to one of its trunk lines near Belcher, in the same parish, is nearing completion. This is the United's second pipe line outlet from the field. The company has allocated a sum of $200,000 to be spent during 1935 in pipe line work in the Shreveport district, of which the Rodessa to Belcher line is the major project.

●

The General Pipe Line Company's 88-mile, 10-in. carrier from Lebec to Torrance, California, is nearing completion. The line will handle approximately 40,000 bbl. of crude daily, and this capacity may be increased later to 60,000 bbl. by the construction of an intermediate booster station. At the present time no booster is being added to the line. One is not deemed necessary, as the elevation of the line drops from 4200 ft. at Lebec to only a few ft. above sea level at Torrance.

The general contractors on the project are the Macco-Robertson Company and the Lang Transportation Company. H. C. Price, Inc., has the contract for the electric welding.

●

Completion of two large producing wells in the Crystal Township pool of Montcalm County, Michigan, has resulted in the construction of several new pipe lines in the central part of the state. The Simrall Pipe Line Company, subsidiary of the Roosevelt Oil Company, is laying a 6-in. line from its Crystal pumping station to the Roosevelt Oil Company refinery at Mt. Pleasant, a distance of 28 miles. The Franklin Tool and Supply Company has been awarded the contract.

Ben J. Skinner, president of the Midwest Refining Company of Alma and Grand Rapids, has announced plans for a 13-mile, 6-in. line from the Crystal field to his refinery at Alma.

The Wolverine Pipe Line Company, a new organization, will lay a 6-in. line a distance of six and a half miles from the Crystal field to Carson City where a 20-car loading rack will be constructed.

The Pure Transportation Company, pipe line subsidiary of the Pure Oil Company, is constructing a 4-in. line from the Crystal field to Carson City to connect with a 10-car loading rack. The capacity of this line will be approximately 11,000 barrels.

●

A lateral to connect the Pan American Refining Company's plant at Texas City, Texas, with the Stanolind Pipe Line Company's East Texas crude oil carrier, is planned. A preliminary survey has been made. Both companies are subsidiaries of the Standard Oil Company of Indiana.

●

The Independent Natural Gas Company, natural gas transportation unit of the Phillips Petroleum Company, is planning to lay approximately 30 miles of 24-in. welded line to connect sour gas production in northeastern Moore County, Panhandle Texas, with natural gasoline and carbon black plants near Sanford in Hutchinson County, it is reported.

●

The Gulf Pipe Line Company is to construct a 16-mile, 6-in. pipe line from its trunk system, near the Judkins-Conell field to the Scharbauer-Goldsmith area in northwestern Ector County, Texas, to connect with two wildcat oil producers recently completed by the Gulf Production Company.

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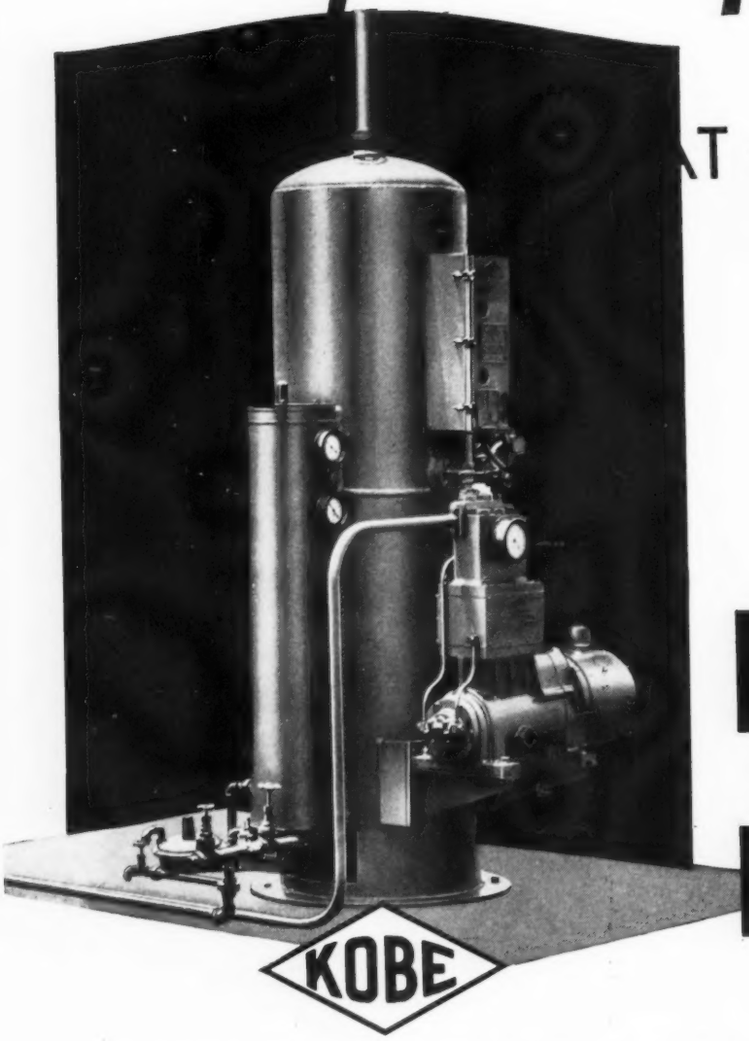

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Kobe pumps in service daily are substantiating, in a very emphatic manner, all previous claims of increased efficiencies, reduced power costs, and more economical pumping of wells of practically any depth.

With average over-all efficiencies of 60% plus, the average power cost of these plants is .2¢ per barrel per 1,000 feet at an arbitrary power rate of 1.¢ per KWH., with pump settings ranging from 2,007 to 7,200 feet.

These figures represent a number of installations in different fields, over a period of approximately four years, under widely varying field, well and operating conditions.

The detailed records of these plants provide ample evidence of the possibilities of greatly extending the present limitations of efficient, economical pumping to wells of practically any depth, and of average or extremely difficult production characteristics. These data will be supplied to production executives on request.

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THE MONTH'S ACTIVITIES IN REFINING

Per Cent Refinery Capacity Operated

Eastern Division, 76.9 per cent **Central Division, 69.7 per cent** **Western Division, 64.7 per cent**

THE Sullivan City Refining Company, of which Ed Sullivan is president and E. C. Couch secretary-treasurer, has placed in operation a small skimming plant at McAllen, Texas. Crude supply is from the Samfordyce field.

●

The Royalite Oil Company's gasoline absorption plant, now under construction on the Sterling-Pacific lease in the South Turner Valley of Canada, is expected to be completed and ready to operate early in July.

●

Plans are being made by the Pan American Petroleum Corporation for the installation of additional units at its Texas City, Texas, refinery. The new equipment will double the capacity of the plant, now capable of processing 25,000 bbl. of crude daily.

●

J. R. Travis of Duncan, Oklahoma, is contemplating the construction of a refinery in Russell County, Kansas. He is now seeking crude contracts for 100,000 bbl. monthly and if successful proposes to move a refinery from Duncan to Russell. It will be a 3500-bbl. skimming plant.

●

The construction program of the Standard Oil Company of California at its Richmond refinery is expected to be completed by July 1. The work was started early this year and consists of the remodeling of existing equipment and the erection of a new lubricating oil unit. The extension of dockage facilities and the laying of large diameter lines from the dock to the refinery already have been completed. The wharf was extended 670 feet. The lines from the dock to the refinery were each approximately a mile in length. A new 20-in. pipe line also has been laid from the wharf to the San Pablo tank farm, a distance of three miles.

●

The Standard Oil Company of California announces the appointment of the Stratford Development Corporation of Kansas City, Missouri, as exclusive licensing agent in all countries for its low-temperature refining process. The process covers the acid-treatment of distillates at controlled, reduced temperatures.

The Mohawk Oil Company has installed three additional compressor units in its Mountain View, California, absorption plant, thereby increasing the intake of wet gas and the gasoline recovery. The installations include two 90-hp. Superior gas engines each driving two 19x20 direct-connected Ingersoll-Rand gas cylinders, and a Gardner-Denver duplex two-stage horizontal compressor actuated by steam.

●

The Model Refining Company of Reeds Switch in the East Texas field is adding a cracking unit to its plant. The capacity of the refinery at present is 1500 bbl. of crude daily.

●

A United States patent has been granted to Dr. R. K. Stratford, head chemist of the Imperial Oil Refineries, Ltd., Sarnia, Ontario, Canada, and Charles B. Leaver of Toronto, on a chemical process whereby clay can be continuously used in connection with tower systems for the purification of oil. The process involves the vaporization of the oils in contact with clay. The vapor is then condensed and mechanically separated from the clay, which is dried by hot gases.

●

Work is progressing on the erection of a 30,000-bbl. combination skimming and cracking unit by the Magnolia Petroleum Company at its Beaumont, Texas, refinery. The M. W. Kellogg Company has been awarded the contract for designing and constructing the new unit, which will replace old equipment that has been in use for many years.

●

Two new refineries are to be erected at Point-aux-Trembles, Canada, according to present plans. Mongeau & Robert Co., Ltd., of Montreal, Quebec, expects to construct a refinery, together with storage facilities, at a total cost of $500,000, while a $3,000,000 refinery and storage outlay is planned by the Pacific Oil Company.

●

A 500-bbl. capacity refinery is under construction at Denver, Colorado, to process gasoline, kerosene, fuel oil, and road oil. A group of Denver business men head the syndicate promoting the project. When the plant is completed the Denver Refining Company will be incorporated to operate the property.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending June 1, 1935

A. P. I. Figures
(Figures in Barrels of 42 Gallons Each)

DISTRICT	Per Cent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	531,000	86.8	16,849	9,967
Appalachian	94.8	92,000	63.0	2,123	686
Ind., Ill., Ky	95.9	343,000	80.9	9,502	4,254
Okla., Kans., Mo.	84.8	249,000	64.8	5,453	4,103
Inland Texas	48.5	70,000	43.8	1,206	1,898
Texas Gulf	96.4	500,000	84.0	5,692	9,280
La. Gulf	96.4	121,000	74.2	1,452	3,428
No. Louisiana-Ark.	90.0	59,000	81.9	299	292
Rocky Mountain	61.9	42,000	70.0	1,002	782
California	92.6	469,000	59.4	9,602	64,046
TOTALS WEEK:					
June 1, 1935	89.5	2,476,000	72.7	53,180	98,736
May 25, 1935	89.5	2,536,000	74.5	53,227	97,657

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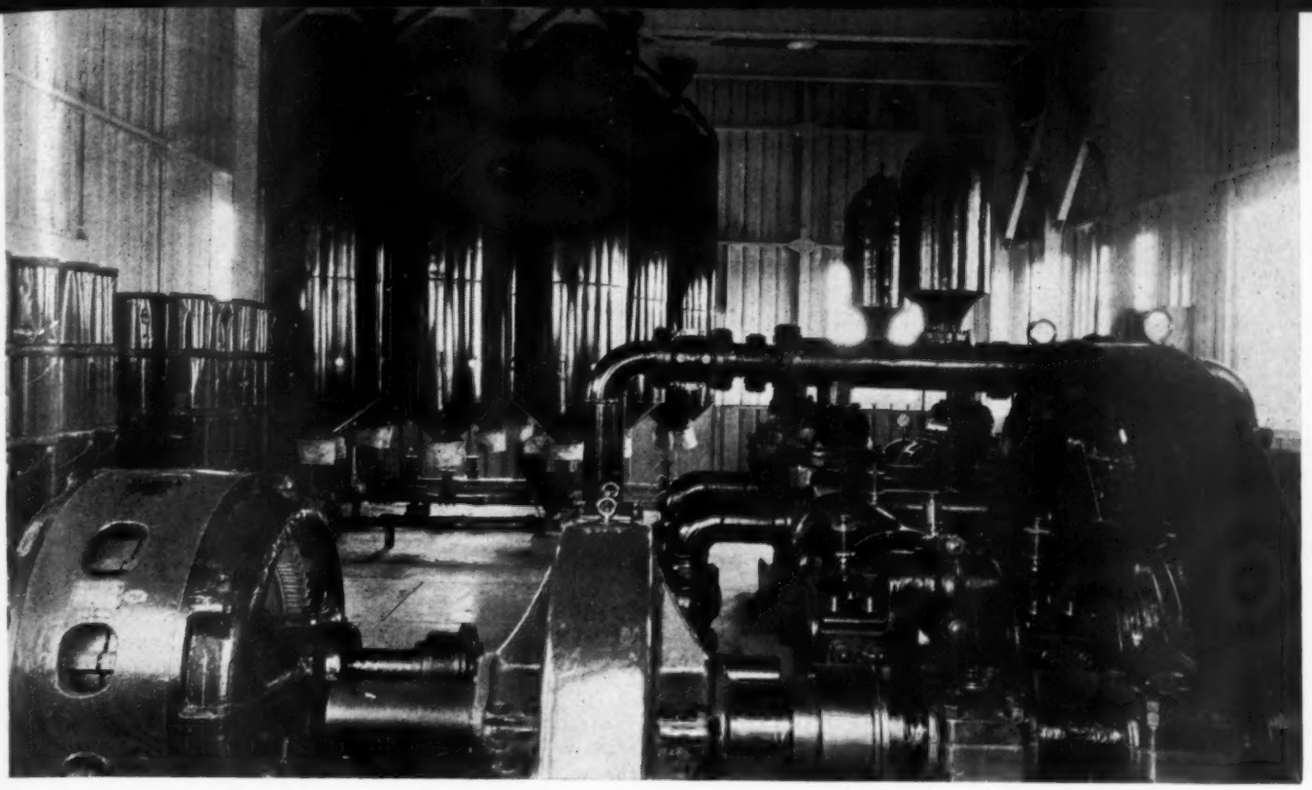


Interior view of foam plant, showing pump and motor in foreground. In background are the chemical bins, beneath which are generators and piping. Extra supply chemicals in pails shown at left.

Efficient Foam Protection System « at Station Tank Farm »

By FRANK H. LOVE

THOSE concerned with providing fire protection for tank farms will be interested in the system installed by the White Eagle Pipe Line Company at its White Station Tank Farm in Butler County, Kansas, approximately six miles from the company's refinery at Augusta. There an old-style, two-solution, wet-system foam plant has been converted into a dry-powder system. So far as possible, equipment on hand was utilized, and such new equipment as was purchased was analyzed carefully in order to obtain the most satisfactory combination.

The Butler County tank farm was obtained by the White Eagle from the Carter Oil Company and, during the time it was in active use by the latter, a two-solution, wet system with a central foam plant was operated. Not having been in use for several years when taken over by the White Eagle, however, the plant was in poor condition. The tank farm includes the southeast, northwest, and southwest quarters of Section 36, T 26 S, R 4 E, in Butler County, although only tanks in the northwest quarter are being used. This group consists of seven 37,500-bbl. and ten 55,000-bbl. steel storage tanks with wooden roofs.

Since officials were desirous of constructing a fire-protective system that would utilize as much of the existing equipment as possible, it was evident that conditions at the tank farm would have to be altered considerably before either of the two foam systems in general use could be adopted in its entirety. One such system is the two-solution wet system, consisting of a central plant at which the two solutions, commonly designated as "A" and "B," are prepared and kept in storage. Pumping facilities and pipe lines for delivering these to the various risks also are necessary equipment. While entirely effective from a fire-fighting viewpoint, certain disadvantages have been found in its operation. Maintaining the solutions at the proper strength requires constant attention and involves considerable expense. Again, a disadvantage of the system lies in the fact that the amount of solution available is limited to the storage capacity provided, and, since one of the solutions is corrosive, suitable storage is expensive to install and maintain.

The other method now in general use attempts to overcome the known disadvantages of the wet-solution system and, at the same time, retain the benefits provided by the use of foam. This method is known as the dry-powder system, and consists of feeding chemicals and water simultaneously to a generator in which they enter instantly into solution. There are two distinct applications of the dry-powder method of creating foam. The first employs a single powder containing all the ingredients necessary to produce foam when properly mixed with water. Since the chemicals in the powder start making foam the instant water is combined with them, it is only practical to attempt to transport the foam to points within 100 to 150 ft. of the generator. At greater distances the back pressure developed makes for unsuccessful operation of the generator. Thus the use of the single dry-powder system is limited to risks having an adequate supply of water immediately adjacent, and at which it is possible to place and operate the generator with safety within the required radius of 150 feet. Means of transporting the necessary supply of powder must be provided and, in addition, an adequate crew must be maintained to keep the generator or generators operating.

Of more recent date even than the single dry-powder system is the one that again separates the foaming agents into two parts, designated as in the old two-solution wet system

as "A" and "B" chemicals.This is called the dual or two dry-powder system in which foam is not formed until solutions from both "A" and "B" chemicals are brought together. Here two generators are employed, making it possible to transport the separate solutions to the risks involved before bringing them together to form foam. The distance the generators can be operated from a risk is dependent upon the amount of pressure the water carrying the chemicals has left after passing through the generators. Here again it is necessary that the generator be operated fairly close to the risk, as the residual pressure available for transporting the solutions is rather low in virtually all instances. As in the case of the single-powder system, chemicals, an adequate supply of water, and men to operate the generators must be available.

Although the methods here described are accepted and in general use by the industry for the protection of risks at which oil fires are likely to occur, neither was found entirely adaptable to conditions at the White Station Tank Farm. Objections to continuing the use of the two-solution, wet system at that tank farm were: (1) a portion of the existing equipment was in such poor condition that replacements would be necessary before the plant could be operated; (2) operating and maintenance costs would be excessive; and (3) some of the equipment is subject to fairly rapid deterioration. Use of the conventional dry-powder systems were objected to because (1) water mains with sufficient pressure were not available near the risks, and installing them would entail considerable expense; (2) due to scattered location of tanks the cost of constructing roads to the various risks, in order that chemicals and equipment could be transported to points near the fire, would be excessive, and (3) it was considered probable that after a fire started considerable time would elapse before enough men could be assembled to transport chemicals and operate the equipment.

The system eventually developed by White Eagle engineers is one flexible and efficient as a fire-fighting unit, at the same time being simple in design and operation. Although the installation as a whole is novel in many ways, every precaution has been taken to assure that the ideas incorporated in it are fundamentally sound and in accordance with accepted practice.

A central plant was constructed in order to avoid the cost of building roads to various parts of the tank farm; also to make possible the handling of a fire with a minimum crew. Since foam solution lines leading from the original plant had been designed for pump operation, it was decided that none of the conventional type dry-powder systems could be utilized without considerable expenditure for larger-sized lines, because, with the comparatively low inlet pressure necessary for successful operation, the residual pressure at the generator outlet would be far too low for the foam to reach any but the nearest risks unless the size of all lines was increased materially. It was decided, therefore, that by permitting the generators to discharge into small surge tanks, the large foam pump that had served the old plant could be used to pick up the solutions and deliver them without difficulty through the existing lines to mixing chambers on even the farthest tanks.

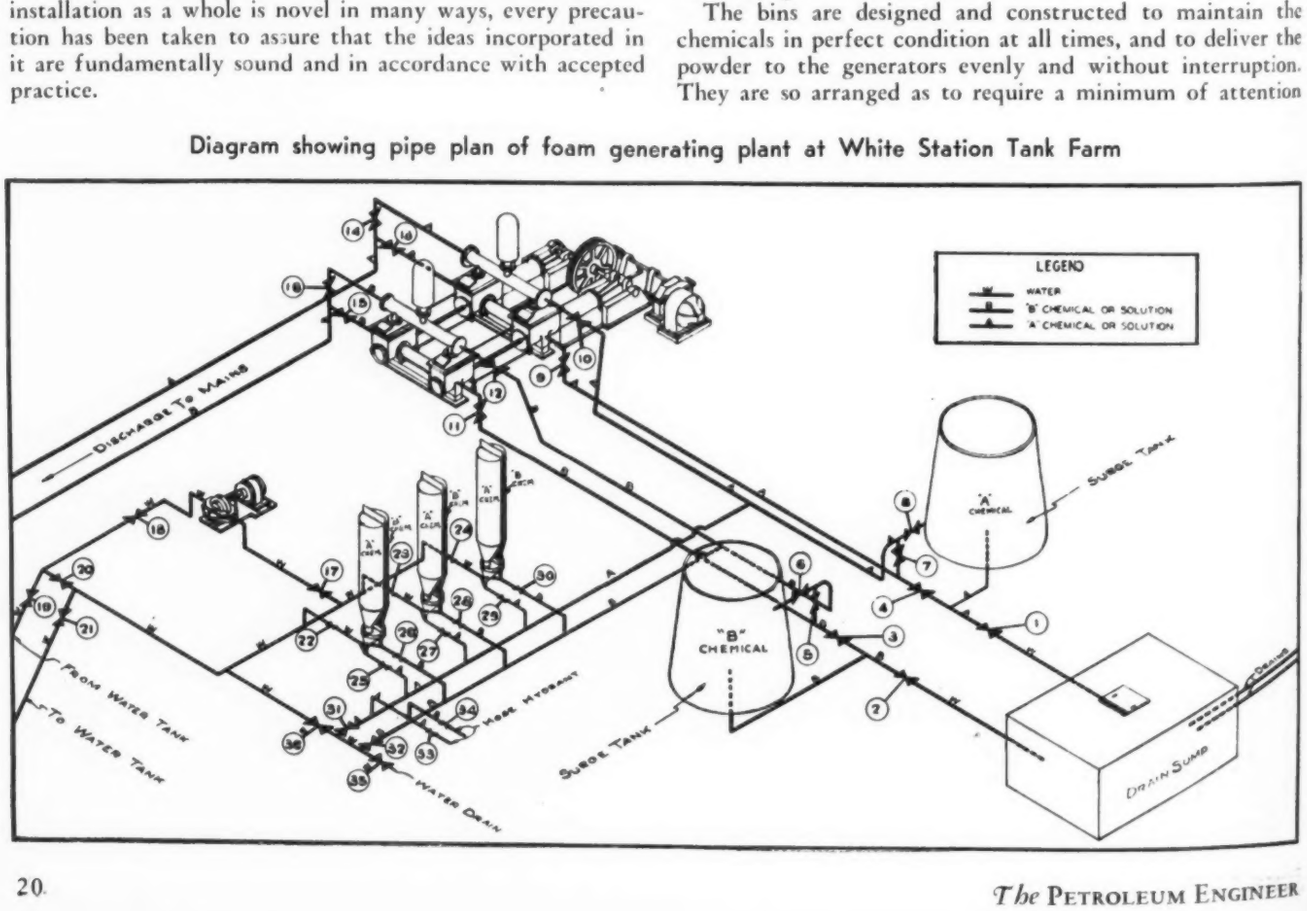
The two-powder system using "A" and "B" chemicals was considered the only method adaptable, since the solutions had to be transported considerable distances. Because of the isolated location of the tank farm the chemicals are stored in overhead bins. To assure a sufficient quantity of water a 37,500-bbl. steel storage tank is utilized, from which the water can be delivered by an electrically-driven centrifugal pump at a pressure of 100 to 125 lb. per sq. in. and at a rate of 1000 gal. per minute.

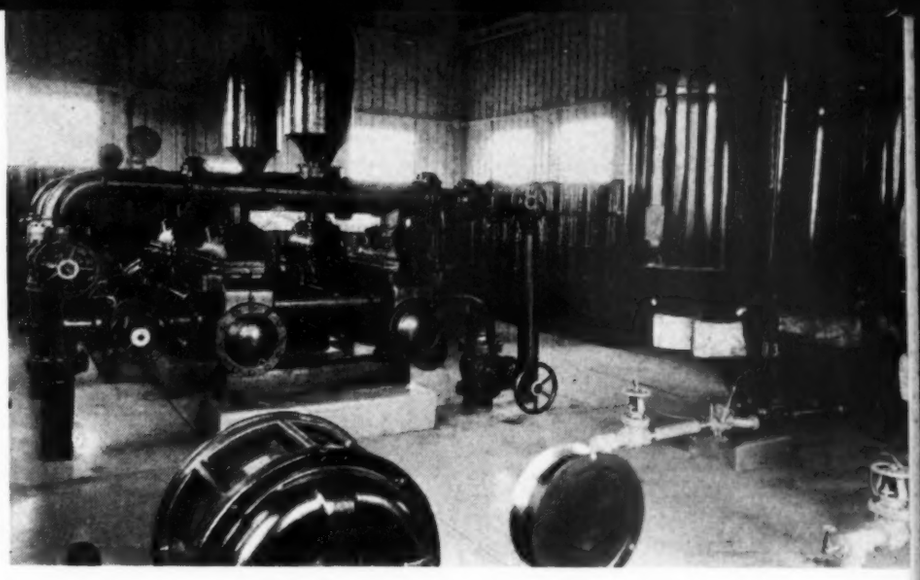
The "A" and "B" chemicals are supplied to the generators from the overhead bins, which, in turn, discharge the separate "A" and "B" solutions to two surge tanks where they are picked up by a 9-in. by 9-in. by 12-in. twin duplex power pump driven by an electric motor and delivered, still as separate solutions, to mixing chambers on the steel storage tanks, or to foam hydrants, as the case may be. Foam is formed in the mixing chambers, the same as would be done if a two-solution wet system were used.

As has been indicated, in addition to the foam chambers, foam hydrant facilities are available at each tank for use with deluge sets and foam towers.

The bins are designed and constructed to maintain the chemicals in perfect condition at all times, and to deliver the powder to the generators evenly and without interruption. They are so arranged as to require a minimum of attention

Diagram showing pipe plan of foam generating plant at White Station Tank Farm





Another view of interior. In place of the conventional floor plate, removable concrete blocks are employed. They can be picked up by an overhead trolley, giving access to the line trenches beneath

and manipulation after being placed in operation. Nine two-compartment bins, three for each generator, are suspended by means of trolleys on beams above the generators. Either compartment in the bin contains 2000 lb. of powder, or a total of 4000 lb. in each of the bins, making 12,000 lb. of chemical instantly available for each generator, and a total of 36,000 lb. in the nine bins. This quantity is sufficient to supply the generators for 30 or 35 minutes. In addition, 12,000 lb. of chemicals are stored in 50-lb. pails.

The three duplex generators have the following characteristics: At 100 lb. per sq. in. inlet pressure each generator requires 315 gal. of water and 304 lb. of chemicals per minute, and will discharge separate "A" and "B" solutions, which, when combined, are sufficient to form 3000 gal., or 401 cu. ft., of foam. These particular generators have a special type valve for instantly shutting off the flow of chemicals and preventing back surge of water wetting chemicals in the hopper and bins. This valve is provided in addition to the check valve on the solution lines that is usual practice. Their construction is of materials capable of withstanding corrosive conditions to which they may be subjected. The generators are installed in such a manner that they can be disconnected readily and used elsewhere as portable units.

Water storage is situated to give flow with a positive head to an electrically-driven centrifugal pump. The centrifugal pump was selected rather than a positive displacement type, since it must deliver water to several foam solution generators, one or more of which might, at times, be shut down. This pump has a maximum capacity of 1000 gal. per min. against a head of 100 lb. per sq. in. and a shut-off head of 125 lb. per sq. in. The generators will operate satisfactorily at pressures ranging from 75 lb. to 125 lb. per sq. in.

The foam pump is a twin duplex, 9-in. by 9-in. by 12-in., and is employed to deliver solutions through the pipe lines to the mixing chambers on the tanks, or to the foam hydrants. It has an output of 535 gal. per min. of each solution, or a total of 1070 gal. per min., being capable of handling that amount against a pressure of 250 lb. per sq. in. A 150-hp. electric motor drives the pump through reducing gears at a rate of 40 to 41 rev. per minute.

Two 65-bbl. wooden tanks serve as surge tanks, one for "A" solution and one for "B" solution. The solutions are pumped into these tanks with considerable velocity and in a manner best to agitate their contents. The reason for such procedure is to cause a swirling motion that will bring any chemicals having a tendency to settle out of solution or suspension directly to the center of the tank, at which point suction lines take off to the solution pump. Provision has been made to prevent the liquid in the tanks from "vortexing," as that might result in the solution pump going on air. Provisions also have been made to keep the solutions agitated should the plant be operating intermittently, as at the end of a fire.

Piping and manifolds at the central foam-generating plant are so arranged that each part is readily accessible for inspection and repair. Flange connections are used throughout. Provision has been made to wash and drain thoroughly each piece of pipe and equipment after the plant has been operated. All piping and manifolds are painted distinctive colors and at a glance members of the personnel can tell accurately for what purpose each is intended. Piping and valves outside the central foam-generating plant also have been painted where exposed to indicate "A" and "B" solutions. In addition to painting all valves, they are numbered, and signs have been placed at points where switching the flow of solutions will occur.

Provision for electric power includes a transformer bank immediately adjacent to the building, having primary voltage of 13,200 and secondary voltage of 440. Power lines are well protected and more sturdily constructed than is usual practice.

The mixing chambers on the tanks have been remodeled to provide for deflection of the foam against the walls of the tanks in order to reduce excessive drop and consequent submergence of the foam. Diaphragms have been installed to prevent condensation or vapors from the tanks collecting in lines leading to the mixing chambers.

The water supply is obtained from Walnut River, two and a half miles distant, made necessary since the water strata underlying the tank farm are difficult to locate and yields from wells are small and uncertain. A 37,500-bbl. steel storage tank was withdrawn from crude oil service and used for water storage. This is filled to two-thirds capacity, making available approximately 20,000 bbl. of water for fire-fighting purposes. Precaution is taken to keep that amount on hand at all times. A small slough running through the property is utilized for impounding any make-up water that may be needed.

With the fire-protective system and equipment considered entirely adequate to serve the purpose for which it was designed, every measure has been taken to assure of its being properly used should the necessity arise. Detailed instructions have been prepared for the guidance of the operating personnel and include the following:

(1) Complete instructions for operating the central foam-generating plant, together with suggestions for clearing any trouble that may occur during its operation.

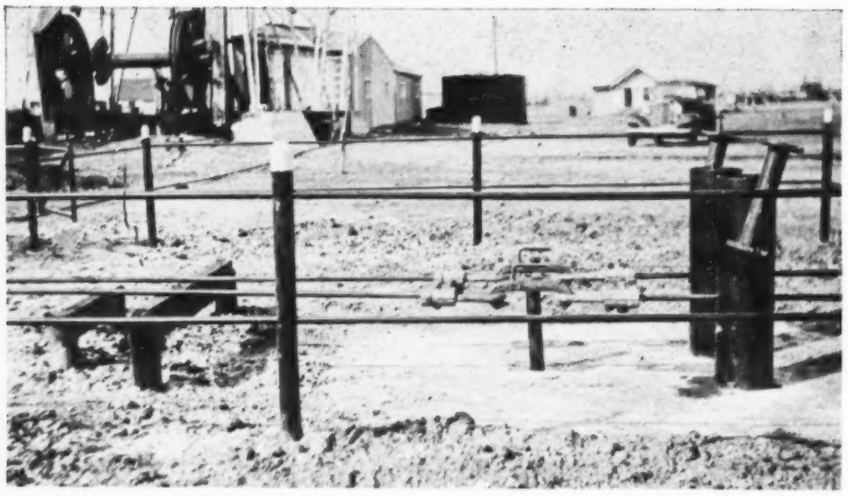
(2) A system of cards, one for each tank in the area, indicating by means of a diagram and printed instructions just which valves are to be opened and which are to be closed in preparing to put out the fire in the particular tank covered by that card.

(3) A contour map of the tank farm and one showing all pipe lines and valves, with the numbers on the latter plainly marked.

(4) A manual in which the most up-to-date methods of combating oil fires are clearly set forth. This contains an organization chart in which responsibility for each phase of the work is delegated to the proper personnel.

(5) A list of all equipment kept on hand for fire fighting, together with information concerning the location of additional supplies of chemicals, tools, and other necessities.

(6) A list of persons to be notified in case of fire and instructions on how they can be reached, has been posted in a conspicuous place and is kept up-to-date.



Double knock-off posts — of the older type — in McPherson County, Kansas. Note the neat enclosure over the stroke post in the picture showing the key rig.

By

VAN D. BENNETT,

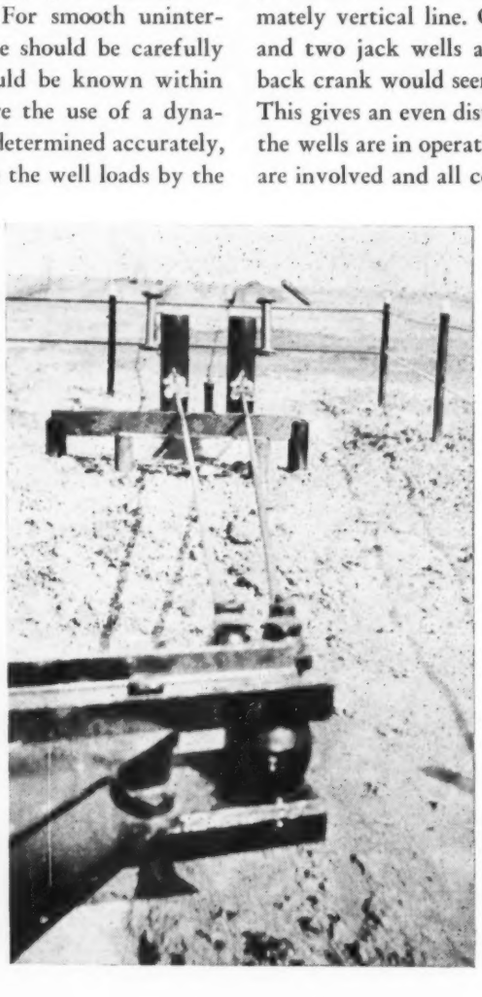
Production Engineer, The Derby Oil Company

PART 2

Backside Crank Pumping in Kansas Fields

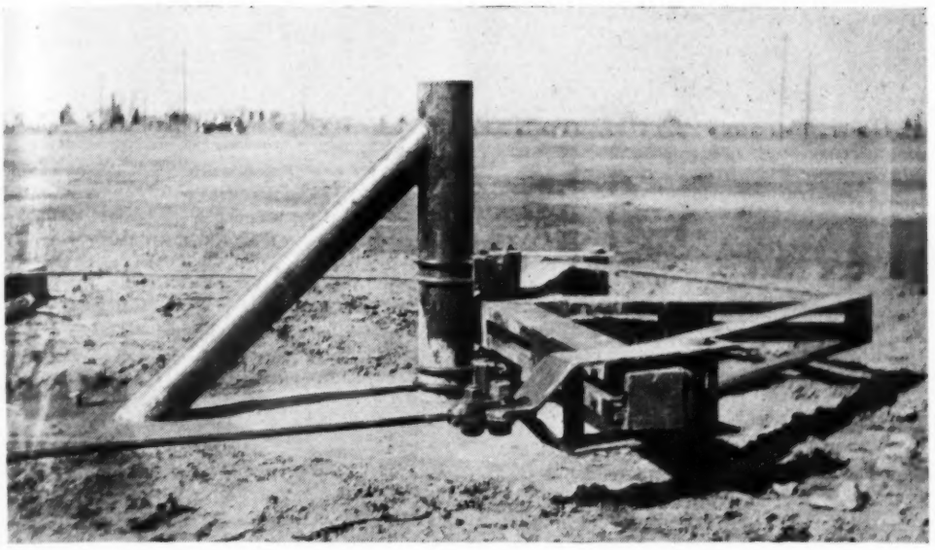
EACH back-crank layout is obviously governed by the local conditions on the lease. For smooth uninterrupted operation, the matter of balance should be carefully considered. The polished-rod loads should be known within a reasonable degree of accuracy. Where the use of a dynamometer is available these loads may be determined accurately, but the common practice is to calculate the well loads by the various formulas in use that take into consideration the depth of the well, diameter of the pump, strokes per minute, length of stroke, percentage of water, diameter of the rods, diameter of the tubing, gravity of the oil, etc. Unquestionably these calculations are subject to considerable error, but they serve as a basis for balancing the load of one jack well against another. The main difficulty encountered is in obtaining a balanced condition when it is necessary to hook-off the key well or one or more of the jack wells.

The position of the back crank in relation to the front crank is quite important in obtaining the proper distribution of the load and the overlapping of the required peak well impulse loads. Where a pendulum type stroke post is employed, the forces on the back crank act parallel to the ground whereas the forces on the key well act in an approximately vertical line. On usual hook-ups where the key well and two jack wells are involved the proper position of the back crank would seem to be 180 deg. from the front crank. This gives an even distribution of the load during the time all the wells are in operation. Where a key well and one jack well are involved and all counterbalance is dispensed with on both wells, the front crank and the back crank should be set at 90 deg. or 270 deg. in relation to each other, thereby causing the loads of the two wells to act in direct opposition to each other.



Two wells operated from one 90-degree swing on a back-crank installation, South Voshell field, McPherson County, Kansas.

Individual counterbalancing of each jack well is probably the simplest method of maintaining any semblance of a balanced condition when some well or wells are hooked off. Individual jack-balancing also relieves considerable strain from the pull rods; however, it has been found in this area that a certain definite limit is reached in the amount of individual jack counterbalancing that may be used, since the paraffin deposits in small wells sometime interfere with



165-degree swing in the Ritz-Decker field, McPherson County, Kansas.

the dropping of the rods. It is therefore found necessary in many cases to dispense with all balance on each jack in order to obtain a greater deceleration at the sucker rods than the stroke-post speed. Where paraffin is troublesome an overbalanced jack causes the knock-off arrangement to unhook automatically and thereby drop the rods.

Horsepower Requirements

The horsepower requirements in this area on an average 3-well job of 3400 ft. depth, using ¾-in. rods and a 1½-in. diameter pump, is approximately five hp. per well. In addition, it is estimated that about four to six hp. are required for operation of the swings, hold-overs, pull rods, etc., thus making a total load of 20 hp., which is easily handled by the 40-hp. two-cycle horizontal engines that are generally in place at the key wells. It has been estimated that under average conditions, the surface equipment hp. requirements for this area are as follows:

Swing—1 to 1½ hp., depending upon angularity.

Stroke posts—1 to 2 hp., depending upon the type and application.

Hold-over—½ to 1 hp., depending upon the angularity.

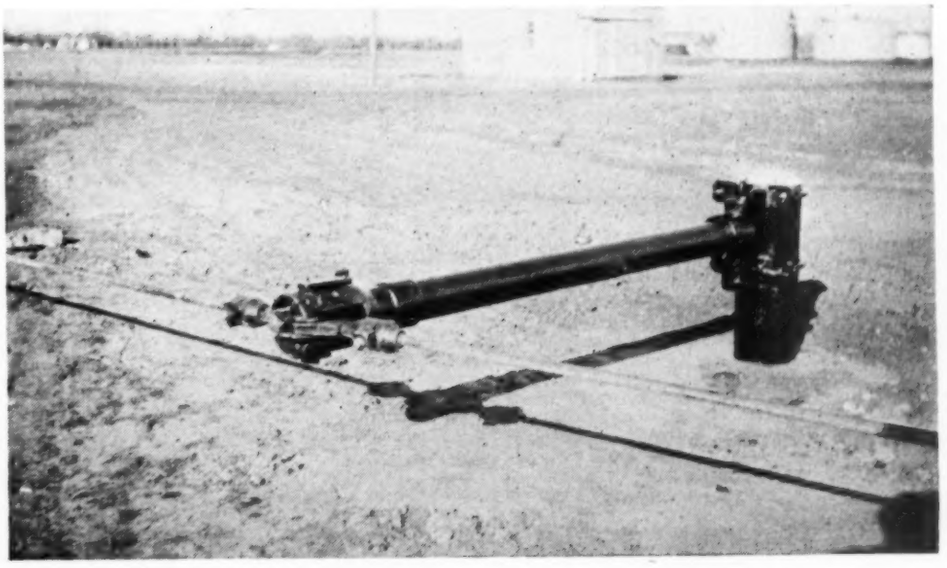
Hold-ups or Hold-downs—About ½ hp.

1-in. rod line per 1000 ft.—2 hp. where oak heads are used, and 1 hp. where roller rod-line carriers are used.

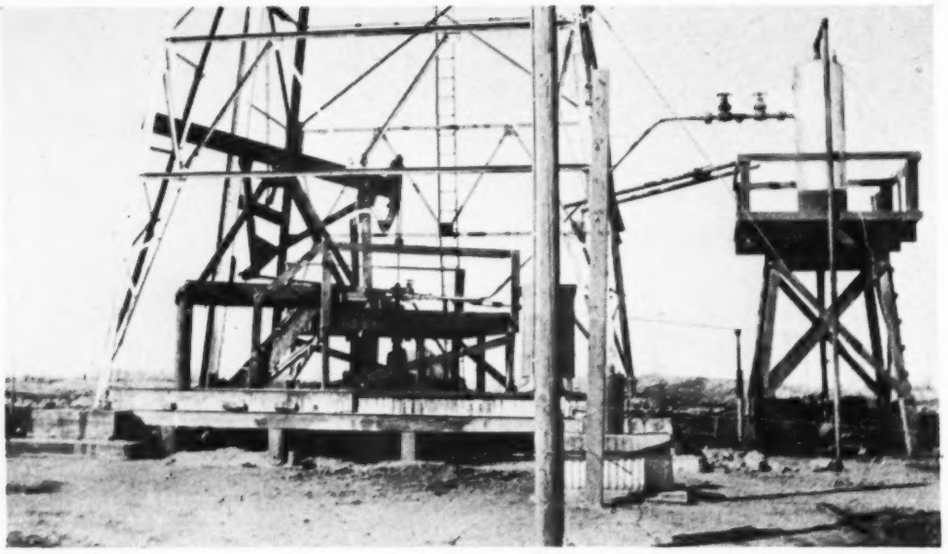
Equipment and Construction

In planning the mechanical details of a back-crank installation the following should be determined: the fluid capacity of each well; the approximate load imposed by each well; the location of the wells with respect to each other; and the adaptability of the proposed installation to the topography of the lease. The key well is usually a well with a larger volumetric fluid capacity, and is chosen with some degree of care in order to obtain the most economical installation. The proper alignment of all equipment and the surface soil into which the concrete foundations for the equipment are to be are important; the soil stresses should be carefully checked in order to prevent mis-alignment caused by settling. Settling and subsequent mis-alignment may become a serious source of power loss and result in excessive bearing wear. The use of roller type rod carriers is quite common and has replaced the use of oak heads in many installations. Where oak heads are used, care is taken to have catenary curves in the pull rod lines to reduce lost motion while in operation. Catenary curves are believed to be of little value where roller type pull rod carriers are used. Upset and 1-in. A.P.I. pull rods are most extensively used, although some installations use ⅞-in. sucker rods for pull rods. Where backside crank equipment is installed exposed to sand and dust storms, such as have been experienced during the past month in this area, the value of dust-proof bearings on all surface equipment is unquestioned.

The pump jacks in use are either of the 12,000-lb. or 16,000-lb. polished rod load under pull type and are equipped with both mechanical type heads and wire line heads. The ratios on the jacks range from 1:1 to 1:8 and the average length of stroke in use is from 30 to 40 inches. The jacks are equipped with machined dust-proof bearings and either with oil bath or pressure grease lubrication. From five to eight



Hold-over of the rigid pipe type equipped with pressure grease lubrication on property in the Voshell Pool, McPherson County, Kansas.



Pump jack powered by back-side crank in the Ritz-Decker field. This is a combination dry-gas and oil well producing from the Chat formation. The height of the bradenhead necessitated the unusual elevation of the pump jack.

yards of concrete is generally used in installing these jacks. Some straight lift feature is generally incorporated in the construction of the pumping head which imparts an almost vertical motion to the polished rod.

Three types of stroke posts in use are the pendulum type, the rocker arm type, and the horizontal roller type. One desirable feature of a stroke post is the obtaining of the minimum angularity of the pull rods in a normal direction from the take-off clevises. The bearings in the stroke posts are probably subjected to the greatest pressures of any in back-crank installations. The projected bearing area available on the bearings in various types of stroke posts should be considered along with the bearing pressures that will be encountered, before specifying any particular make. Pendulum type stroke posts are built with either structural steel frames or pipe frames.

Slide-bar knock-off posts are generally used although there are several installations where the old type knock-off posts using the knock-off block and disconnecting-hook are used. Self-aligning wristpin bearings of the spherical type are especially desirable for wristpin bearings since they permit slight misalignment in any direction.

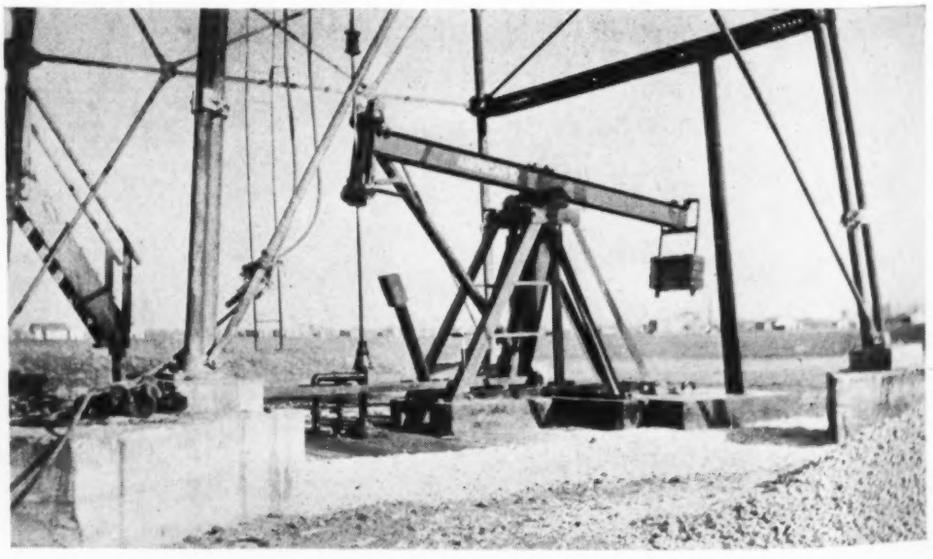
Both 2-hole and 3-hole A.P.I. cranks of the split hub or solid hub types, with either tapered or straight holes, are employed. A 2-hole split hub crank is probably desirable in most instances since the third hole is seldom if ever used in a back-side crank installation. Most stroke posts are connected to the first hole of the cranks.

Rigid swings of 80 to 180 deg. as well as swings adjustable from 30 to 110 deg. are used. The bearings of the swings are oil bath or pressure grease lubricated and are usually dust-proof. Some types of swings have a stroke length adjustment at either outer bearing. Where a slight deflection of the pull rod line is desired a hold-over is used instead of a swing, and the rigid pipe type of hold-over seems to be rapidly gaining in popularity over the bull ring and C-C clamp type formerly used.

In case it is found necessary to install an extension shaft in order to clear the existing machinery or engine house, a cast-iron or cast-steel flange is used to secure the extension shaft to the primary bandwheel shaft. This shaft is supported by an extra steel jack-post set just inside the back crank. Obviously, the correct alignment of this shaft is of the utmost importance.

An outstanding feature of a recent installation is the complete elimination of C-C clamps. Special pull-rod connections on the swings, stroke posts, jacks, turn-buckles, and hold-overs make this possible. Another small refinement on this job is use of several self-aligning roller pull-rod carriers. These are designed to take the side thrust of the pull rods where they take off from a swing or hold-over and by eliminating flexing increase the life of the pull rods.

When back crank equipment replaces standard pumping rig fronts it necessitates the use of some type of portable pulling units for rod and tubing operations and also the use of a portable cleaning-out unit for subsequent well-reconditioning. Most companies operating backside crank equipment have employed these two types of portable pulling units for some time. At the time the jack is set it is customary to set



Pump jack (16,000-lb. capacity) operated from back crank on oil lease, McPherson County, Kansas; depth of wells 3400 ft.

Hold-down with pipe frame in use on lease in Ritz-Decker area, Kansas.

a tubing floor block base. With one of these bases set at each well it is only necessary to bolt the floor block to the base in order to be rigged up for a rod or tubing job. It is also customary to bury a joint of old pipe and secure wire line loops to it for use as a dead man in anchoring the portable well-servicing unit. The cost of installing the floor block base and the dead man for the unit should be included in making an estimated cost of a backside crank installation.

The itemized estimated cost of an average 3-well hook-up consisting of one key well and two jack wells for an estimated depth of 3400 ft. and the length of line, 660 ft. is as follows:

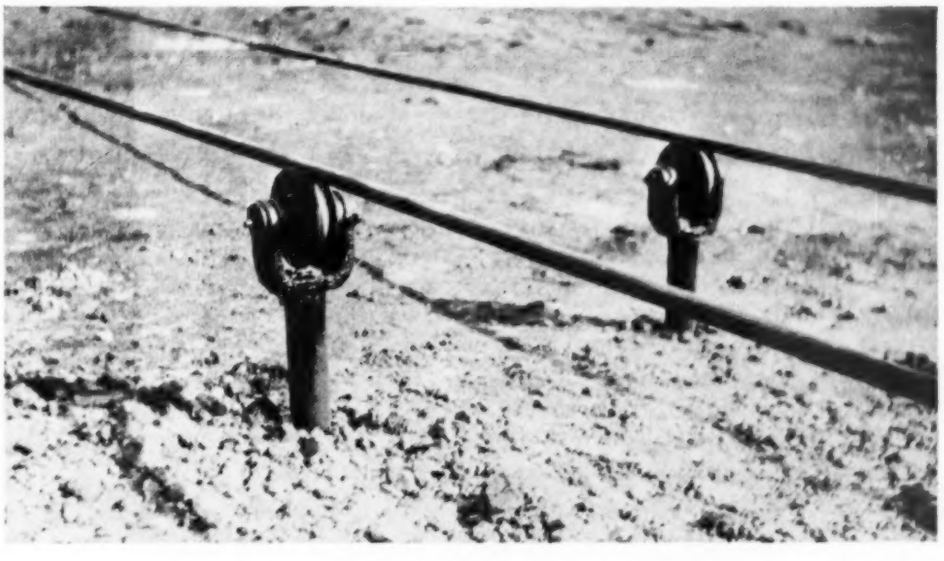
Equipment	$1,250.00
Concrete	200.00
Contract Labor, Installing	500.00
Company Labor and Overhead	100.00
Welding, Trucking and Miscellaneous	150.00
Total estimated cost of the installation	$2,200.00

An estimate may vary from 40 per cent less to 20 per cent more than that given, depending upon the relative location of the wells, the local topographic conditions, the type of equipment chosen, and the degree of refinement desired in the construction.

It is only natural that the application of the backside crank principle of pumping deep wells should be accompanied by a certain amount of equipment failure and construction errors. While these failures and errors have not assumed any degree of seriousness they are of sufficient importance to justify their mention in order that future installations that are trouble free may be developed.

Bearing failure has been experienced in the lower bearing of the stroke post to which the pull rod clevises are attached. This is a particularly susceptible point for bearing trouble when two wells are attached (one to each side) and a slight amount of play develops in the bearing. The reversal of the peak load from one side of the bearing to the other tends to cause failure of both the bearing and the pin. The installation of back crank drives from wooden fronts should be avoided on deep well hook-ups since it is very difficult to maintain a rigid structure; serious misalignment and failure of bearings may result. The breaking of jack-post turnbuckles has been common where the key well was equipped with a wooden front. Pull rod line breaks may constitute a serious danger to the jacks and stuffing boxes, as well as certain subsurface equipment, unless a headache post is installed to break the fall of the jack. A small investment for a jack headache post may save an expensive breakdown. All pull-rod lines should be run with the aid of a transit. Dog leg lines, run by eye, may result in a serious loss of power, may set up unnecessary flexing of the rods, and are conducive to premature pull-rod failure.

It is a big field for the equipment manufacturer and presents unlimited economies to the operator. The successful application of the backside crank principle of pumping will be governed by analyzing each proposal individually and by giving proper considération to all factors involved. It is a field that presents to the operator unlimited opportunities for economies, and to the equipment manufacturer a challenge to his mechanical ingenuity.



Roller rod-line carriers in use on lease in McPherson County, Kansas.

The Manufacture, Packaging, and Shipping of Oxidized Asphalts

By
CHARLES J. HOLLAND

Article 5

ASPHALT PLANT NO. 3

INTERESTING and instructive suggestions on the utilization of asphalt-producing crude oils in Germany are afforded from a study of Plant No. 3, which is at Hamburg. A statement on conditions that influenced decision for its erection seems advisable to be given first.

Since the year 1902 and with only minor changes in the law, Germany has maintained, with important exceptions, a high import duty on all mineral oils, both crude and refined. As there has been little home industry to protect, this tariff law has always existed for revenue purposes only. From time to time certain revisions and exceptions have been made. Some years ago, in order to assist home industries manufacturing tires, roofing materials, paints, certain chemicals, etc., better to compete in the world markets and also to encourage road building and use of industrial Diesel engines, certain types of industrial naphthas, gas oils, and asphalts were allowed to be imported duty free or at greatly reduced assessments. All petroleum products over a certain specific gravity were allowed entrance free of duty. Gas oil for certain specified uses carried a duty of about one and a half cents per gallon.

These exceptions on gas oils, asphalts, and very heavy crudes opened up an opportunity for a company possessing heavy Mexican of Venezuelan crude production, to obtain excellent earnings from the operation in Germany of a modern asphalt plant.

Accordingly, the owners of Plant No. 3 some five years ago began at Hamburg the erection of such a plant for the processing of 5000 bbl. daily of Ebano-Panuco crudes. Hamburg was the best site offered because of deep water and free port facilities, allowing for re-export to other European ports. The plant has been operating a little over four years. Products manufactured are crude benzene, gas oils, road oils, fluxes, and asphalts.

It was unusually expensive construction. A portion of the site was made by driving sheet piling over a large area and back-filling of three to eight ft. in depth with sand from the harbor bed. For the foundations, everything except tankage, piling had to be driven 30 to 40 ft. in length. Building and objectionable odor emission regulations were very strict. All buildings and stacks had to be of concrete or brick construction. Much expense was involved in eliminating objectionable refining odors, from distillation, steam, and oxidation units. Construction work was carried on during the most severe winter experienced in Germany in 50 years. This necessitated extra expenses not met with under favorable weather conditions. Lastly, contracts were let on a cost-plus basis and, as time was extremely important on account of delayed construction schedules resulting from the weather, little attention was given toward obtaining the best available prices for men and materials.

Figs. 9, 10, and 11 give flow diagrams of distillation and

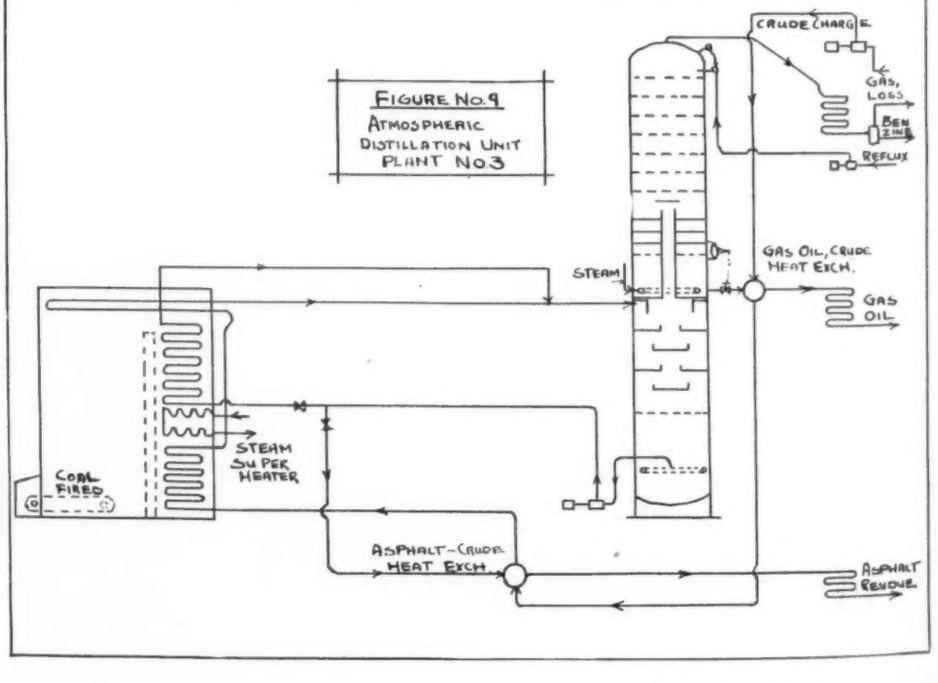


FIGURE No. 9
ATMOSPHERIC DISTILLATION UNIT PLANT NO. 3

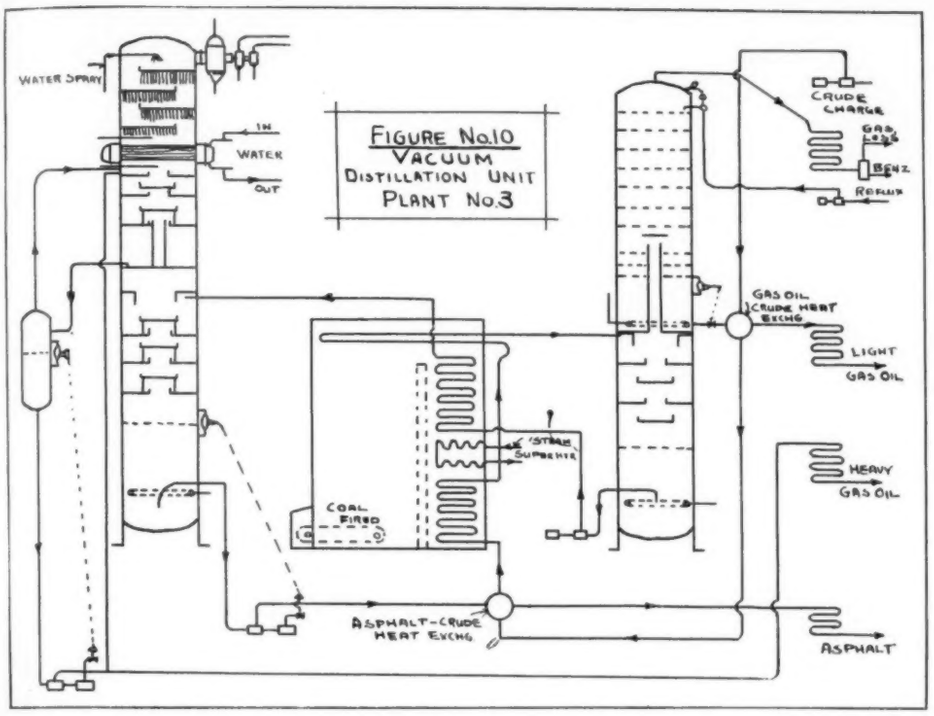


FIGURE No.10
VACUUM DISTILLATION UNIT
PLANT No.3

oxidizing units. These, as well as boilers, were fired with coal because it was cheaper than oil or gas. The coal often came from England, and accounts for the overhead crane method of delivery, from water shipments, as may be seen from Fig. 12. English coal was as cheap as, and sometimes cheaper than, German coal due to a provision in the Versailles Treaty specifying there was to be for a long period of years no German import duty on coal of English origin.

Fig. 12 is an airplane view of Plant No. 3 showing also the Shell plant across the channel. The most noticeable feature is the extraordinary height of smoke stacks, expensive pieces of equipment made necessary on account of severe municipal ordinances relating to control of smoke and obnoxious fumes from industrial plants.

The distillation equipment consisted of two 2500-bbl. combination atmospheric and vacuum pipestills. For oxidation there were two horizontally-placed fire-heated batch stills 14 ft. dia. by 30 ft. long, taking a charge of 600 bbl. and yielding 90 tons of finished asphalt per batch. Assuming an average 4-day cycle for pumping in and out, heating up, oxidizing, cleaning and repairs, this would give an average daily capacity for the two stills of:

$$\frac{90}{4} \times 2 = 45.0 \text{ tons of finished asphalt.}$$

Table 2 gives the typical analyses of the four grades of oxidized products manufactured as of 1930; Table 3, the six grades being offered for sale in Germany as of Feb., 1934; Table 4, the steam-refined products.

In 1930 the writer had occasion to refer at length to Plant No. 3 in a special consulting report entitled: "The Utilization of Panuco Crude in Germany." The remaining paragraphs of this section are quoted therefrom:

"Four grades of steam-refined asphalt are manufactured, numbers one, three, six, and nine of respective penetration specifications of 30/40, 50/60, 90/100, and 120/150. Representative asphalt yields being obtained are: No. 1, 57.02 per cent; No. 3, 60.60 per cent; No. 6, 67.98 per cent, and No. 9, 71.62 per cent.

"In the beginning all products were marketed at wholesale through jobbers. Later, a subsidiary marketing company was organized. It took over the assets and business of a prominent Hamburg jobber who retained a 52 per cent interest in the new company. The net-back on the various grades

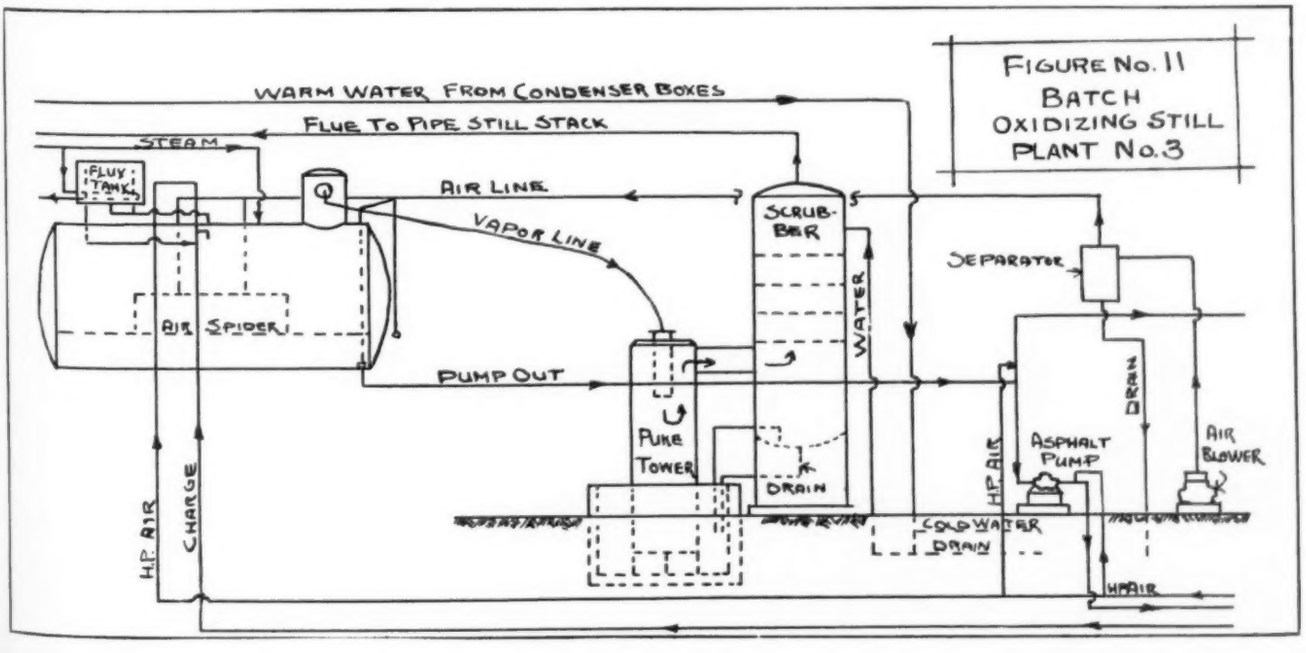


FIGURE No. 11
BATCH OXIDIZING STILL
PLANT No.3

TABLE 1

Actual plant yields and estimated costs and realizations from processing 3000 bbl. daily 12-gr. Mexican crude by means of high-vacuum distillation

Products Mf'd	Value Per Gal.	Yields	Total Value Per Bbl. of Crude Processed
Crude Benzene	10c	7.0%	$0.294
Light Gas Oil	4c	17.0	0.285
Heavy Gas Oil	5c	12.6	0.265
No. 3 Asphalt	9½c	60.5	2.414
Losses		2.9	
Totals		100.0	$3.258
Less: Crude @ Tampico	$1.000		
Trans. to Hamburg	0.880		
Direct Op'g Costs	0.260		
Fixed Chgs. & Ovh'd	0.387		
Selling Expense	0.100		2.627
Net operating Profit per bbl. crude processed			$0.631
" " " " day			1,893.00
" " " " year (320 days)			$605,760.00

TABLE 2

Typical Analyses of Blown Asphalts Plant No. 3

Grade Number		No. 10	No. 11	No. 12	No. 14
Specific Gravity at 25°C... (77°F.)		1.038	1.042	1.046	1.060
Melting-Point per	(Deg. C.)	55-65	65-75	80-90	115-125
Kraemer-Sarnow	(Deg. F.)	131-149	149-167	176-194	239-257
Melting-Point per	(Deg. C.)	65-75	75-85	90-100	125-135
Ring-and-Ball Method	(Deg. F.)	149-167	167-185	194-212	257-275
Flash-Point in	(Deg. C.)	290-310	300-320	320-340	340-360
Open Cup	(Deg. F.)	554-590	572-608	608-644	644-680
Solubility in Carbon-Bisulphide		99.8%	99.8%	99.8%	99.8%
Penetration at 25°C	(77°F.)	30-50	20-30	10-20	5-10
Solidification Point	(Deg. C.)	20	20	20	20
	(Deg. F.)	68	68	68	68
Combined Carbon		16-18%	16-18%	17-19%	19-22%
Combined Sulphur		6%	6%	6%	6%

TABLE 3

Plant No. 3

Standard specifications of oxidized asphalt used in Germany

Grade No.	Deg.	Melting Point: Ring & Ball	Melting Point: Kraemer-Sarnow	Drop Point	Break Point	Penetration	Ductility	Fire Point
I	C.	67-75	54-64	82-92	Under −10	40-50	10-20	Over 240
	F.	153-167	129-147	180-198	" +14			" 464
II	C.	80-90	65-75	95-105	" −5	20-30	5-15	" 250
	F.	176-194	149-167	203-221	" +23			" 482
III	C.	98-108	80-90	110-120	" −2	10-20	2-5	" 260
	F.	208-226	176-194	230-248	" +30			" 500
IV	C.	110-120	94-104	130-140	" −1	10-20	2-3	" 270
	F.	230-248	201-219	266-284	" +30			" 518
V	C.	130-140	112-120	145-155		6-10	1-2	" 280
	F.	266-284	234-248	293-311				" 536
VI	C.	165-175	145-155	180-190		2-5		" 290
	F.	329-347	293-311	356-374				" 554

Table 4

Typical analyses of steam-refined asphalts Plant No. 3 (in Germany)

Grade No.	Sp. Gr.	M.P. K.S.	M.P. R-B.	F.P. O.C.	B.P. O.C.	Sol. CS_2	Ductility	Pen.	Carbon	Sulphur
1	1.035	122	140	555	625	99.99	25+	25	18%	6%
3	1.045	104	122	535	610	99.99	100+	40	16%	6%
5	1.040	95	113	525	600	99.99	100+	80	14%	6%
6	1.035	90	108	500	580	99.99	150+	85	14%	6%
8	1.032	84	102	465	545	99.99	150+	120	14%	6%
9	1.030	80	97	430	520	99.99	150+	170	13%	6%

of asphalt in tank cars F.O.B. refinery was around $25 per ton, equivalent to 9½ cents per gallon.

"Using for illustration the manufacture of grade No. 3 asphalt, Table 1 gives a fairly accurate idea of results to be expected over a period of the next two years."

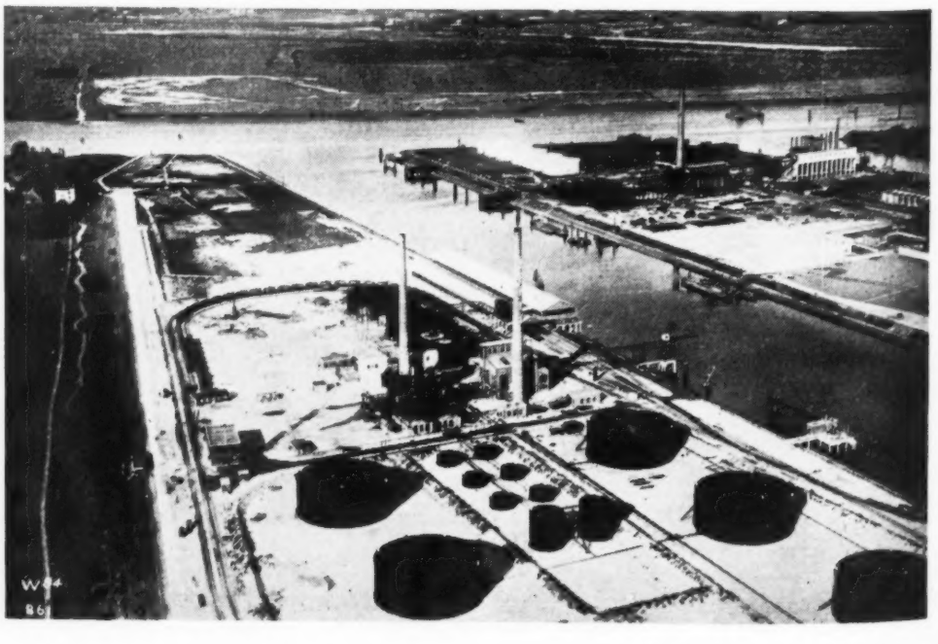


Fig. 12. Airplane view, Plant No. 3, Hamburg, Germany

Polymer Gasoline from Cracked Gases

By V. N. IPATIEFF* and GUSTAV EGLOFF*

A COMMERCIAL polymerization unit recently put into operation is processing 3,000,000 cu. ft. a day of cracked gas and producing about five gallons of polymer gasoline per 1000 cu. feet. This gasoline has an octane rating of 80-82 Motor Method, and its blending value is higher than that of benzene or isooctane.

The process is that developed by the Universal Oil Products Company and reported at the recent New York meeting of the American Chemical Society.

The unit is operating under mild conditions of temperature and pressure, using a solid catalyst. The stabilizer gas being processed contains about 29 per cent of propylene and butylenes.

Cracked gases are made up of paraffin hydrocarbons and also members of the olefinic series, including ethylene, propylene, and butylenes. These olefins react at relatively low temperatures and pressures in the presence of the solid catalyst to produce polymer gasoline.

The following data were obtained from the operation of two pilot polymerization plants of 400 and 85,000 cu. ft. daily capacity.

Polymerization of Stabilizer Gas Obtained From Reforming Mid-Continent Straight-run Gasoline

A continuous 22-day run was made in a semi-commercial polymerizing plant. The operating conditions were about 3500 cu. ft. of gas per hour, temperature 475 deg. fahr., and 160 lb. gauge pressure. The gas being processed was passed through a heating coil under the stabilizer pressure of 160 lb. and delivered into the three insulated catalyst chambers connected in series flow.

In the first part of the run the hydrogen sulphide (0.8 per cent by volume) was not removed from the stabilizer gas and part of it appeared in the polymer gasoline as sulphur compounds, mostly mercaptans, due to the interaction of hydrogen sulphide with the olefins present in the gas. In the second part of the run the hydrogen sulphide was removed from the stabilizer gas before polymerization by scrubbing with 23 deg. Baumé caustic soda solution.

The sulphur present in the polymer gasoline is a function of the hydrogen sulphide content of the gas being processed. With caustic scrubbed gas the sulphur content of the liquid polymer approaches zero. In the present run the polymer gasoline produced from the unscrubbed gas contained 0.63 per cent of sulphur (76 per cent of which was mercaptans) whereas the gasoline from the scrubbed gas was doctor sweet and contained only 0.02 per cent of sulphur.

The compositions of the inlet gas to the process and of the outgoing gas are presented in Table 1, the values being obtained by low temperature Podbielniak distillation. Hydrogen sulphide was removed from the gas before distillation. Columns 1 and 2 list the actual analytical figures of the inlet and outlet gases, whereas column 3 has been corrected for the shrinkage of the gas due to polymerization. Columns 1 and 3, therefore, represent the relative volumes of the various components of the ingoing and outgoing gases. That is, for every hundred cu. ft. of inlet gas there was 74.7 cu. ft. of outlet gas. The routine analytical method used in plant control consisted in the absorption of propylene and butylenes by means of 87 per cent sulphuric acid.

*Universal Oil Products Company Research Laboratories, Chicago, Illinois.

Polymerization of Stabilizer Gas Containing Hydrogen Sulphide

Run data obtained with unscrubbed stabilizer gas (containing 0.8 per cent of hydrogen sulphide) are presented in Table 2, which shows the operating conditions, the olefin content of the gas, the extent of olefin polymerization, and the yield of liquid polymer.

Distillation and other characteristics of the crude liquid polymer as produced are presented in Table 3.

Polymerization of Stabilizer Gas Free from Hydrogen Sulphide

The stabilizer gas containing 0.8 per cent of hydrogen sulphide was passed from the stabilizer of the reforming unit through a 23 Baumé caustic soda solution at 150 deg. fahrenheit. This treatment reduced the hydrogen sulphide to less than 0.01 per cent.

Run data from this part of the 22-day run are shown in Table 4.

Distillation and other characteristics of the crude liquid polymer as produced are presented in Table 5.

Polymerization of Gas Obtained from "Vapor Phase" Cracking of Mexican Gas Oil

In the vapor phase cracking of Mexican gas oil, gases containing various percentages of olefins are produced. A blend of the absorption tower and stabilizer tower gases was made in the proportion in which they were produced in a commercial cracking unit making 6,500,000 cu. ft. of gas per day, five volumes of absorption gas to one of stabilizer.

The mixed gas was polymerized at 175 lb. gauge pressure, temperatures of 450 and 500 deg. fahr., and at feed rates of 3.9 and 5.6 cu. ft. per hr. per lb. of catalyst.

Analyses of the inlet and outlet gases are listed in Table 6. Columns 1 and 2 give the actual gas analytical figures,

TABLE 1

Analyses of Inlet and Outlet Gases

Gas	1 In, %	2 Out, %	3 Out, % x 0.747
Non-Condensibles	5.5	2.4	1.8
Ethylene	2.9	5.0	3.7
Ethane	13.4	33.9	25.2
Propylene	15.3	4.9	3.7
Propane	39.4	37.6	28.2
Isobutylene	3.8	0.3	0.2
n-Butylenes	5.9	1.4	1.1
Butanes	12.9	14.5	10.8
Pentanes and Higher	0.9	0.0	0.0
Total	100.0	100.0	74.7

TABLE 2

Operating Conditions	
Hours on Test	444
Gauge Pressure, lb./sq. in.	160
Temperature, °F.	475
Inlet Gas Rate, cu. ft./hr.	3430
Outlet Gas Rate, cu. ft./hr.	2566
Higher Olefin Content of Inlet Gas	
Propylene and Butylenes, %	26.2
Higher Olefin Content of Outlet Gas	
Propylene and Butylenes, %	8.3
Olefin Polymerization	
Propylene and Butylenes, %	76
Liquid Polymer Production	
Gal. per 1000 cu. ft.	4.7

TABLE 3
Crude Liquid Polymer (from Unscrubbed Gas)

Gravity, °A.P.I. at 60°F	69.5
Gum, mg./100 cc. (Copper Dish)	23
Gum, mg./100 cc. (Air Jet)	16
Percent Sulphur, Total	0.63
Percent Sulphur, Mecaptan	0.48
Octane Number (C.F.R. Motor Method)	82
Induction Period, Minutes	90
Reid Vapor Pressure at 100° F., Lb	12.8
100 cc. A.S.T.M. Distillation	°F.
Initial B.P	89
Percent Distilled Over	
10	140
20	169
30	192
40	204
50	214
60	227
70	245
80	289
90	355
End Point	415
Total Percent Over	95
Percent Bottoms	1
Percent Loss	4

whereas the values in column 3 have been corrected for the change in gas volume due to polymerization. That is, for

TABLE 4

Operating Conditions	
Hours on Test	93
Gauge Pressure, lb./sq. in	160
Temperature, °F	475
Inlet Gas Rate, cu. ft./hr	3520
Outlet Gas Rate, cu. ft./hr	2617
Higher Olefin Content of Inlet Gas	
Propylene and Butylenes, %	24.4
Higher Olefin Content of Outlet Gas	
Propylene and Butylenes, %	9.7
Olefin Polymerization	
Propylene and Butylenes, %	71
Liquid Polymer Production	
Gal. per 1000 cu. ft	3.6

TABLE 5
Crude Liquid Polymer (from Scrubbed Gas)

Gravity, °A.P.I. at 60°F	67.2
Gum, mg./100 cc. (Copper Dish)	51
Gum, mg./100 cc. (Air Jet)	10
Percent Sulphur, Total	0.02
Percent Sulphur, Mercaptan	0.0
Octane Number (C.F.R. Motor Method)	82
Induction Period, Minutes	45
Reid Vapor Pressure at 100° F., Lb	10.6
100 cc A.S.T.M. Distillation	°F.
Initial B. P	94
Percent Distilled Over	
10	158
20	186
30	199
40	207
50	215
60	224
70	241
80	277
90	333
End Point	415
Total Percent Over	95
Percent Bottoms	1
Percent Loss	4

TABLE 6
Analyses of Inlet and Outlet Gases

Gas	1 In, %	2 Out, %	3 Out, % x 0.787
Non-Condensibles	19.8	26.4	20.8
Ethylene	14.9	17.5	13.8
Ethane	19.8	26.5	20.8
Propylene	19.4	7.2	5.7
Propane	18.2	19.4	15.2
Isobutylene	1.8	0.0	0.0
n-Butylenes	3.8	0.0	0.0
Butanes	1.5	3.0	2.4
Pentanes and Higher	0.8	0.0	0.0
Total	100.0	100.0	78.7

every hundred cu. ft. of inlet gas there was 78.7 cu. ft. of outlet gas.

Table 7 presents run data showing the operating conditions, the olefin content of the gas before and after polymerization, and the yield of liquid polymer.

Table 8 presents distillation and other characteristics of the crude liquid polymer as produced.

TABLE 7

Test Number	1	2
Operating Conditions		
Hours on Test	60	264
Gauge Pressure, lb./sq. in	175	175
Temperature, °F	450	500
Inlet Gas Rate, cu. ft./hr./lb. of catalyst	3.9	5.6
Higher Olefin Content of Inlet Gas		
Propylene and Butylenes, %	26.3	27.2
Higher Olefin Content of Outlet Gas		
Propylene and Butylenes, %	7.5	4.2
Olefin Polymerization		
Propylene and Butylenes, %	77	88
Liquid Polymer Production		
Gal. per 1000 cu. ft	3.7	3.8

Polymerization of Stabilizer Gas Obtained from "Liquid-Vapor Phase" Cracking of Mid-Continent Gas Oil

The stabilizer gas was processed at 100 and 155 lb. gauge pressure and 450 deg. fahr. with varying time factors. The contact times were varied from 24 to 173 seconds. The propylene-butylene content of the gas averaged 35 percent. The liquid polymer production per 1,000 cu. ft. ranged from 5.6 to 8.4 gallons.

TABLE 8
Crude Liquid Polymer

Test Number	1	2
Gravity, °A.P.I. at 60°F	59.7	60.2
Sulphur, %	0.14	0.14
Octane Number (C.F.R. Motor Method)	80	80
Reid Vapor Pressure at 100° F., Lb.	5.3	5.6
100 cc. A.S.T.M. Distillation	°F.	°F.
Initial B.P.	135	121
Percent Distilled Over		
10	198	188
20	216	204
30	229	216
40	240	228
50	256	239
60	274	259
70	299	286
80	328	318
90	390	370
End Point	487	476
Total Percent Over	96.5	97.0
Percent Bottoms	1.0	1.5
Percent Loss	2.5	1.5

TABLE 9
Analyses of Inlet and Outlet Gases

Gas	1 In, %	2 Out, %	3 Out, % x 0.671
Non-Condensibles	0.0	0.0	0.0
Ethylene	0.7	1.1	0.7
Ethane	6.1	10.0	6.7
Propylene	18.4	3.5	2.3
Propane	46.3	71.8	48.3
Isobutylene	4.4	0.2	0.1
n-Butylenes	10.1	2.4	1.6
Butanes	13.1	9.8	6.6
Pentanes and Higher	0.7	1.2	0.8
Hydrogen Sulphide	0.2	0.0	0.0
Total	100.0	100.0	67.1

Table 9 presents average gas analytical data for the inlet and outlet gases. Columns 1 and 2 list the actual gas analysis figures, whereas the values in column 3 have been corrected for the change in gas volume due to polymerization.

The processing of the stabilizer gas was continued for eight days during which time four different sets of operating conditions were tested in order to determine the effect of contact time on the quality of the liquid polymer. The results are shown in Tables 10 and 11.

Table 11 presents distillation and other characteristics of the crude liquid polymer as produced during the four tests.

TABLE 10

Test Number	1	2	3	4
Operating Conditions				
Hours on Test	48	48	48	42
Gauge Pressure, Lb./Sq. In	100	155	155	155
Temperature, °F	450	450	450	450
Inlet Gas Rate, cu. ft./hr./lb. of catalyst	1.1	4.4	6.7	11.4
Higher Olefin Content of Inlet Gas				
Propylene and Butylenes, %	37.5	34.6	34.3	36.0
Higher Olefin Content of Outlet Gas				
Propylene and Butylenes, %	0.3	4.0	6.2	10.4
Olefin Polymerization				
Propylene and Butylenes, %	99	92	87	79
Liquid Polymer Production				
Gal. per 1000 cu. ft.	8.4	7.4	6.6	5.6

The boiling range of the polymer product does not affect the octane rating to any extent.

Table 12 presents data from the above runs, which show the effect of contact time upon the extent of polymerization and upon the yield and boiling range of the liquid polymer.

TABLE 11
Crude Liquid Polymer

Test Number	1	2	3	4
Gravity, °A.P.I. at 60°F	62.7	66.4	67.8	66.6
Sulphur, %	0.12	0.23	0.32	0.31
Octane Number (C.F.R. Motor Method)	81	80	82	81
Reid Vapor Pressure at 100° F., Lb	14.0	13.9	14.0	12.5
100 cc. A.S.T.M. Distillation				
	°F.	°F.	°F.	°F.
Initial B.P.	95	89	84	104
Percent Distilled Over				
10	158	164	148	166
20	188	194	182	189
30	210	209	196	199
40	235	221	211	206
50	258	234	222	214
60	292	254	238	225
70	327	290	262	244
80	372	328	310	293
90	460	420	372	352
End Point	531	439	413	411
Total Percent Over	94.0	91.5	92.0	93.5
Percent Bottoms	1.5	1.5	2.0	2.0
Percent Loss	4.5	7.0	6.0	4.5

TABLE 12
Effect of Contact Time on Extent of Polymerization and Yield and Boiling Range of Polymer

Test Number	1	2	3	4
Contact Time, seconds	173	65	42	24
Inlet Gas Rate, cu. ft./hr./lb. of catalyst	1.1	4.4	6.7	11.9
Polymerization of Propylene and Butylenes, %	99	92	87	76
Gal. of Liquid Polymer/1000 cu. ft. of gas	8.4	7.4	6.6	5.2
90 Percent Point, °F	460	420	372	351
End Point, °F	531	439	413	41

Polymerization of Propane-Propylene and Butane-Butylene Fractions

In some refineries the stabilizer for producing the vapor pressure gasoline desired is operated so as to yield a propane-propylene and a butane-butylene fraction or mixtures thereof. These separate fractions and a mixed fraction were studied with the view to producing liquid polymer and substantially olefin-free gas; i.e., propane, butane, or a mixture of propane and butane.

The gases were processed at 450 deg. fahr. and 100 lb. pressure at gas rates of 0.05 to 0.25 cu. ft. per hr. per lb. of catalyst. Under these operating conditions, 92 to 99 per cent of the olefin content of the gas was removed in the form of liquid polymer.

Analyses of the inlet and outlet gases are given in Table 13 following. Columns 1 and 2 show the actual gas analysis figures, whereas the values in column 3 have been corrected for the change in gas volume due to polymerization.

Run data are presented in Table 14 showing the operating conditions, the olefin content of the gases before and after polymerization, the extent of olefin polymerization, and the polymer yields. Each gas was processed at two feed rates.

TABLE 13
Analyses of Inlet and Outlet Gases

	Propane-Propylene Fraction			Butane-Butylene Fraction			Propane-Propylene Butane-Butylene Fraction		
Gas	1 In, %	2 Out, %	3 Out, % x 0.828	1 In, %	2 Out, %	3 Out, % x 0.604	1 In, %	2 Out, %	3 Out, % x 0.620
Non-Condensibles	0.8	0.8	0.7	2.2	6.1	3.7	6.7	6.0	3.7
Propylene	28.9	0.0	0.0	4.4	2.0	1.2	10.0	2.2	1.4
Propane	70.3	93.8	77.6	9.1	27.8	16.8	29.4	47.2	29.3
Butylenes	0.0	0.0	0.0	33.6	0.5	0.3	28.0	2.3	1.4
Butanes	0.0	0.0	0.0	50.7	60.2	36.3	25.9	42.3	26.2
Pentanes & Higher	0.0	5.4	4.5	0.0	3.4	2.1	0.0	0.0	0.0

TABLE 14

	Propane-Propylene Fraction		Butane-Butylene Fraction		Propane-Propylene Butane-Butylene Fraction	
Test Number	1	2	3	4	5	6
Operating Conditions						
Hours on Test	20	20	20	12	17	22
Gauge Pressure, lb./sq. in.	100	100	100	100	100	100
Temperature, °F.	450	450	450	450	450	450
Inlet Gas Rate, cu. ft./hr./lb. of catalyst	0.12	0.05	0.19	0.10	0.25	0.10
Olefin Content of Inlet Gas						
Propylene and Butylenes, %	26.6	29.3	35.0	41.0	39.6	43.6
Olefin Content of Outlet Gas						
Propylene and Butylenes, %	2.6	0.4	4.6	0.4	3.4	1.4
Olefin Polymerization						
Propylene and Butylenes, %	92	99	92	99	95	98
Liquid Polymer Production						
Gal. per 1000 cu. ft.	3.8	3.0	8.4	7.2	7.5	7.5

Distillation and other characteristics of the crude liquid polymer are presented in Table 15.

TABLE 15
Crude Liquid Polymer

	Propane-Propylene Fraction		Butane-Butylene Fraction		Propane-Propylene Butane-Butylene Fraction	
Test Number	1	2	3	4	5	6
Gravity, °A.P.I. at 60°F.	57.9	59.3	60.5	60.3	62.5	60.2
Sulphur, %	0.37	.....	0.02	.....	0.02	0.03
Reid Vapor Pressure at 100° F., lb	.....	.....	15.6	.....	.....	16.3
100 cc. A.S.T.M. Distillation						
	°F.	°F.	°F.	°F.	°F.	°F.
Initial B.P.	110	104	80	90	84	100
Percent Distilled Over						
10	180	148	136	128	116	154
20	204	172	186	164	156	196
30	224	194	228	202	198	230
40	246	216	256	232	230	258
50	270	250	290	262	258	286
60	302	286	330	304	294	326
70	338	330	372	358	350	374
80	384	374	422	404	420	428
90	460	431	574	538	570	612
End Point	570	516	574	586	602	612

Properties of Polymer Gasoline

The outstanding characteristic of polymer gasoline is its high octane number and blending value. The distillation range can vary considerably without affecting its antiknock qualities, as shown in Table 16.

TABLE 16
Antiknock Characteristics of Polymer Gasoline

Gravity, °A.P.I. at 60°F.	62.7	59.9	66.4	67.8	66.6
100 cc. A.S.T.M. Distillation					
	°F.	°F.	°F.	°F.	°F.
Initial B.P.	95	94	89	84	104
Percent Distilled Over					
10	158	145	164	148	166
20	188	181	194	182	189
50	258	268	234	222	214
90	460	484	420	372	352
End Point	531	510	439	413	411
Octane Number (C.F.R. Motor Method)	81	81	80	82	81
Octane Blending Value (25% in Fuel A-3 of 44 Octane Number; C.F.R. Motor Method)	118	118	116	120	116

Polymer gasoline has higher blending value (Table 17) than either benzene or isooctane, although its straight octane value is lower, 81 versus 97 and 100, respectively. Its blending value becomes higher, the lower the octane number of the base fuel with which it is blended.

TABLE 17
Octane Blending Value of Polymer Gasoline

(A) Polymer Gasoline Blends					
Percent of Polymer Gasoline in Blend	5	10	15	20	25
Octane Blending Value					
In 45 Octane Number Base Fuel	125	125	121	120	117
In 55 Octane Number Base Fuel	125	120	115	113	111
In 65 Octane Number Base Fuel	105	105	105	105	103
(B) Benzene Blends					
Percent of Benzene in Blend	5	10	15	20	25
Octane Blending Value					
In 45 Octane Number Base Fuel	84	85	84	84	86
In 55 Octane Number Base Fuel	84	85	88	90	89
In 65 Octane Number Base Fuel	84	85	88	90	91
(C) Isooctane Blends					
Percent of Isooctane in Blend	5	10	15	20	25
Octane Blending Value					
In 45 Octane Number Base Fuel	94	94	94	96	96
In 55 Octane Number Base Fuel	90	91	95	98	99
In 65 Octane Number Base Fuel	90	90	95	97	97

(D) Straight Octane Numbers	
Polymer Gasoline	81
Benzene	97
Isooctane	100

Tables 18 and 19 list the octane numbers of various blends of steam-distilled polymer gasoline (E. P., 390 deg. fahr.) with straight-run and with reformed gasoline.

TABLE 18
Octane Ratings of Blends of Polymer and Straight-Run Gasoline

Polymer Gasoline in Blend, %	100	0	5	10	15	25
Straight-Run Gasoline in Blend, %	0	100	95	90	85	75
Octane Number of Blend (C.F.R. Motor Method)	80	44	48	52	56	62

TABLE 19
Octane Ratings of Blends of Polymer and Reformed Gasolines

Polymer Gasoline in Blend, %	100	0	5	10	15	25
Reformed Gasoline in Blend, %	0	100	95	90	85	75
Octane Number of Blend (C.F.R. Motor Method)	80	72	73	74	75	76

Table 20 shows the distillation characteristics of the three gasolines — polymer, straight-run, and reformed — used in these blends.

TABLE 20
Distillation Characteristics of Gasolines Used in Blending

	Gasolines		
	Polymer 100 cc. °F.	Straight-Run A.S.T.M. °F.	Reformed Distillation °F.
Initial B.P.	138	142	122
Percent Distilled Over			
5	178	174	149
10	193	190	163
20	208	207	185
30	218	220	203
40	228	237	220
50	239	249	236
60	251	255	252
70	272	266	270
80	296	283	290
90	327	304	318
End Point	390	360	366

Figs. 1 and 2 (See Page 87) present graphically the blending characteristics of polymer gasoline at different concentrations in a number of base fuels. The family of curves in Fig. 1 makes it possible to predict approximately the octane number that can be expected from blending polymer gasoline with different motor fuels.

The boiling range of the liquid polymer is a function of the operating conditions. By proper choice of the time, temperature, and pressure variables, the distillation range of the liquid polymer can be varied at will. The sulphur content of the polymer gasoline can also be controlled. In case a sulphur-free crude polymer is desired, the gas being processed is freed from hydrogen sulphide before polymerization. This is readily accomplished by a caustic soda wash.

Crude polymer gasoline has low oxygen bomb stability, but high susceptibility to inhibitor. One hundredth of one percent (0.01%) of wood distillate inhibitor is usually sufficient to produce a gasoline of satisfactory stability.

Table 21 lists the gum, oxygen bomb stability, antiknock, and other characteristics of four typical crude polymer gasolines as produced in a semi-commercial plant from stabilizer gas.

Reactivation of the Catalyst

The solid catalyst gradually loses its activity with continued use but it is readily regenerated with a controlled volume of air, which burns off the highly polymerized or carbonaceous material that deposits upon the catalyst. This reactivation step has been carried out a number of times,

TABLE 21
Crude Polymer

	1	2	3	4
Gravity, °A.P.I. at 60° F.	65.9	68.0	68.1	67.8
Gum, mg./100 cc. (Copper Dish)	15	34	38	44
Gum, mg./100 cc. (A.S.T.M.)	4	11	6	8
Induction Period, minutes	35	60	50	45
Ind. Per. + 0.01% Wood Distillate Inhibitor		260	205	305
" " + 0.025% " " "	235	660	510	595
" " + 0.05% " " "	430	1030	835	845
Percent Sulphur, Total	0.77	0.02	0.02	0.04
Percent Sulphur, Mercaptan	0.54	0.002	0.007	0.006
Octane Number (C.F.R. Motor Method)	80	80	81	81
Octane Blending Value (25% in Fuel A-3; O. N. 44; C.F.R. Motor Method)	114	116	120	120
Reid Vapor Pressure at 100° F., lb	9.4	10.8	10.5	8.6
100 cc. A.S.T.M. Distillation				
	°F.	°F.	°F.	°F.
Initial B.P.	115	100	102	107
Percent Distilled Over				
5	146	125	148	132
10	160	143	156	152
20	184	177	178	180
30	199	193	196	196
40	209	203	205	206
50	219	211	214	212
60	232	221	222	219
70	254	236	243	235
80	294	266	270	261
90	337	326	336	326
End Point	409	418	418	409
Total Percent Over	94.5	97.0	97.0	97.0
Percent Bottoms	1.5	1.4	1.5	1.5
Percent Loss	4.0	1.6	1.5	1.5

each time bringing the catalyst back to its original activity. The 22-day run reported in this paper was made with a catalyst that has been regenerated in the tower used for polymerization.

Grateful acknowledgment is hereby made for the assistance of Dr. B. B. Corson, Mr. E. R. Kanhofer, Mr. W. H. Hubner, and Dr. F. J. Skowronski.

SUMMARY

Experiments are described concerning the polymerization of five samples of cracked gases in semi-commercial polymerization units. The operating conditions of gas rate, temperature, and pressure varied from 0.05 to 11.4 cu. ft. per hr. per lb. of catalyst, 450 to 500 deg. fahr., and 100 to 175 lb. per sq. in. gauge pressure. The yields of liquid polymer ranged from 3.0 to 8.4 gal. per 1000 cu. ft. with olefin polymerizations of 71 to 99 per cent.

The outstanding characteristic of polymer gasoline is its high octane number and blending value. Its distillation range can vary considerably without effecting its antiknock qualities, and it has higher blending value than either benzene or isooctane, although its straight octane number is lower, 81 versus 97 and 100, respectively.

The oxygen bomb stability of polymer gasoline is low but its inhibitor susceptibility is high.

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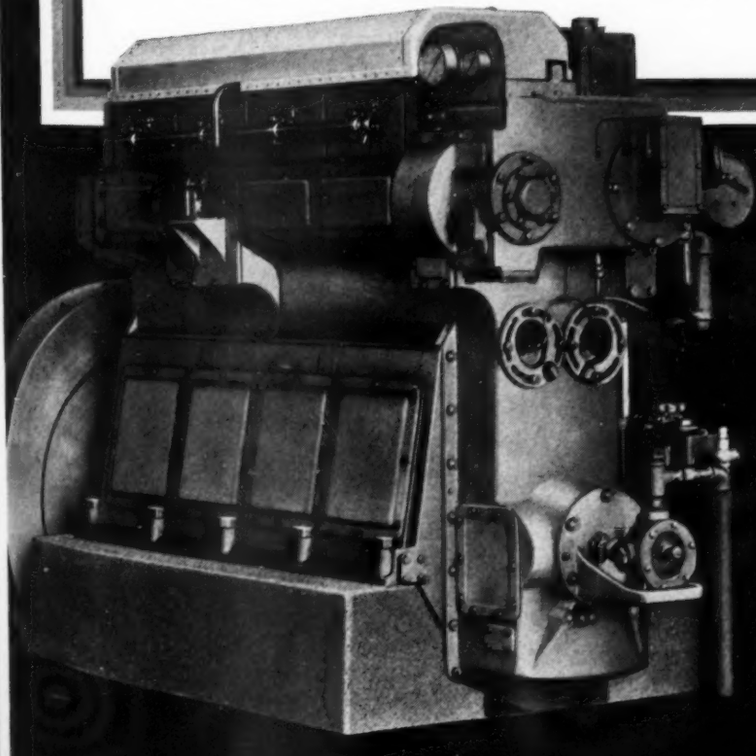

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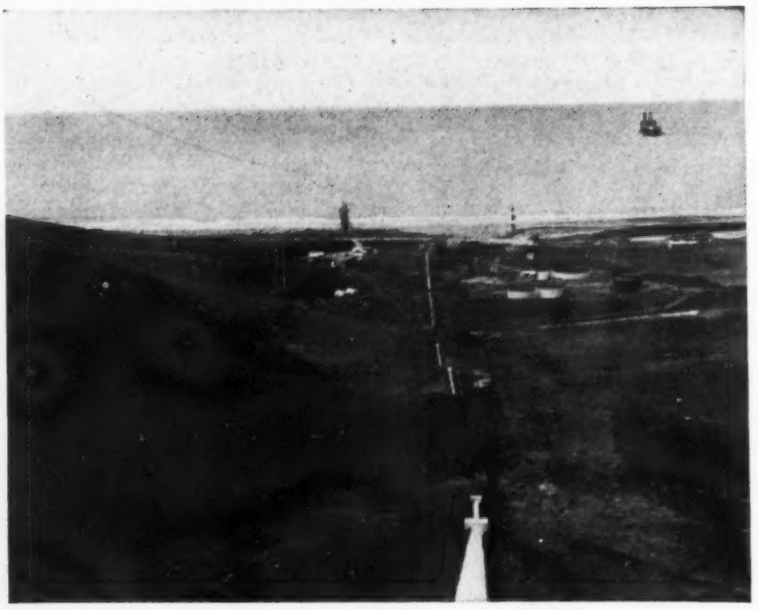


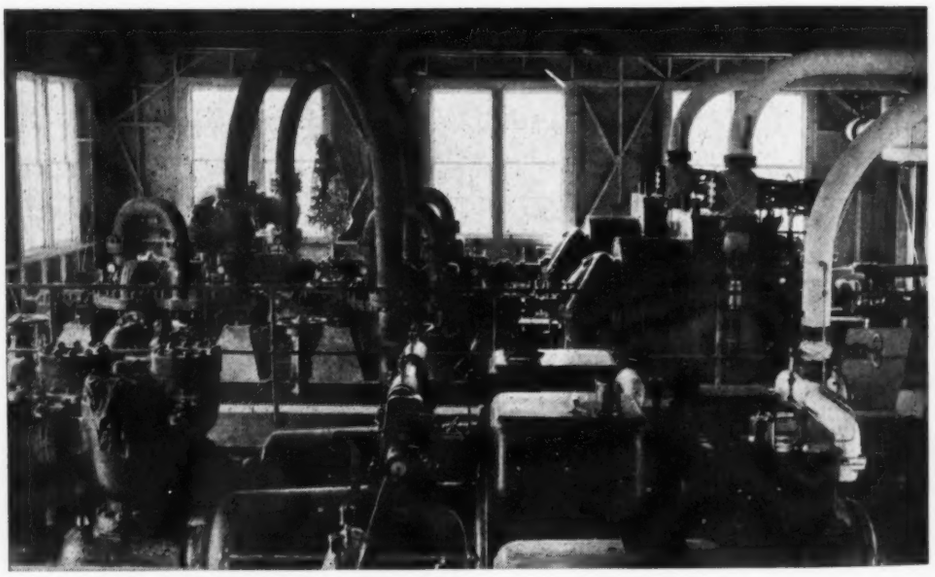
Loading terminal at Estero, showing ship at mooring

Construction of this 108-mile trunk line and additional terminal facilities is good example of efficiency and economy gained by careful planning

By J. C. ALBRIGHT

Rio Bravo–Estero Pipe Line

THE Standard Oil Company of California recently completed and has placed in operation a new pipe line to handle crude from the San Joaquin Valley fields in which this company has oil production. The new line, which was constructed largely from reclaimed pipe taken from loops in the Kern River-Richmond pipe line, runs (see accompanying map) in a northwesterly direction from a point about equidistant between the Midway-Sunset fields and the Kern River-Bakersfield productive areas, where a terminal was built called the Rio Bravo station.



Interior of Shandon pumphouse. Pumping facilities at this station include two turbo-rotary units, one to pump oil from Kettleman Hills through a 10-in. line, the other to pump through the new 12¾-in. O.D. Rio Bravo-Estero line.

Some 96 miles of the old 12¾-in. O. D. pipe was dug up and salvaged from the pipe line to Richmond and transported by truck and trailer to Kettleman Hills, where the company built what is said to be one of the largest and most extensive pipe reclamation plants ever attempted by one company, and the largest that this company has operated. The project was begun about the middle of September, 1934, and completed about March 15, 1935. Approximately six months was consumed in handling the pipe, laying it in the new ditch, and building the extension to the Estero marine terminal. The improvements at each terminal, Estero and Rio Bravo, construction of seven stations, and the building of steel storage tanks required the investment of approximately $4,000,000, and used the labor of about 1000 men continuously for the elapsed time.

After the pipe was transferred to the reclamation plant at the Kettleman Hills yard, it was necessary to clean it thoroughly both inside and outside, reject any joints that had developed corrosion pits of any consequence, and remove the collars and threaded ends. Gas-fired ovens were constructed in which the pipe, in the original 20-ft. lengths, was placed and subjected to a temperature of about 1100 deg. fahr., which caused all traces of the previously applied bituminous coating to be completely burned away and also loosened the oxidized scale that had formed on the surface of the metal. After passing through the ovens, the pipe was rolled to the cooling racks, where it was sand-blasted down to a clean bright surface and again inspected. Each pit was marked by the inspectors and when a joint was found to be in such a condition that a large amount of welding was required to fill the corroded parts, it was discarded. Other pipe passed through the spot welders' tables in order that the surface

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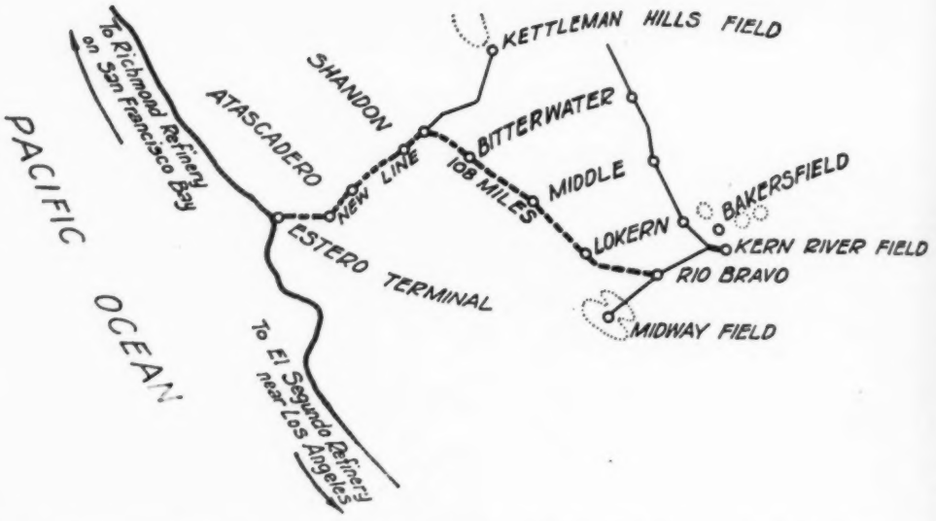
LUFKIN

Route of the new 108-mile Rio Bravo-Estero trunk line



could be brought up to a specified condition.

Cutting tables came next in line, with the operators using equipment to remove the threaded ends of the joints, employing guide collars that placed the burning tips at the desired angle to obtain the necessary bevel for subsequent welding. Cutting operators were supplied with a petroleum product named by the Standard Oil Company, "Calol Liquid Cutting Gas," which is said to require about 80 per cent of the oxygen ordinarily used with other methods, and in addition to the saving in supplies, the cutting tips prepared the ends with an exceptionally clean beveled surface. The clean sand-blasted joints of pipe were welded in approximately 40-ft. lengths in the pipe yard, turned by mechanical means as the joints were being completed. This method was found to be more efficient, as well as being accomplished with a decided saving of labor and material, than had the same welding been done in the field along the pipe line right-of-way. As each length was completed, equipment was used that plugged the open ends of each length of pipe and put a pressure of about 110 lb. of air inside the joints while inspectors passed upon the welds. The surface of the pipe was also checked to determine if pinholes had been overlooked under previous inspection, and if any were found, the spotwelders filled them with metal.

The corrosiveness of the soil traversed by the new pipe line was determined by making an exhaustive soil analysis, using the Shepard Rod and the Corfield Nipple and Can methods, together with other methods developed by other engineers. Soils showing a minimum amount of potential corrosion were plotted, and the completed 40-ft. lengths of reconditioned pipe were transported to the field without the necessity of applying pipe protective methods or coating. A portion of the soil on this right-of-way indicated that the pipe would deteriorate rapidly and joints intended for service in these areas were rolled from the welding racks to the pipe line coating equipment. This coating has been developed by Standard Oil Company and named by it "Somastic Pipe Coating," which has been tested for a period of about six years under the joint auspices of the Bureau of Standards and the A.P.I. Results have shown that this type of pipe line protective coating, when used by Standard Oil Company and others, is very effective, and possesses sufficient inherent strength to resist soil stresses.

The preliminary steps preparatory to coating pipe with Somastic involves the brush application of a thin primer coat of a specially compounded asphaltic paint developed for use with this coating. The primer provides a dust-free surface closely related in character to the mastic that follows, and supplies the necessary tight bonding that occurs when this surface is subsequently fused into the hot mastic. When this preliminary coating is being applied, the pipe is rolled to the racks provided for this operation and workmen introduce heating elements inside the joints of pipe so that the primer coat will penetrate through the surface inequalities. The heater consists of a special burner small enough easily to enter the pipe, attached to a joint of smaller pipe that serves both as a handle and a conduit for the flow of fuel.

In general, this type of pipe line protective coating and hot asphalt road pavement have much in common, both in appearance and method of preparation. Somastic comprises an accurately graded mineral aggregate composed of selected sands and limestone dust combined in the proportions to give a maximum mixture density necessary to provide the desired mechanical strength. Petrolastic asphalt having a penetration of 16 and a small proportion of asbestos fiber are also included in the formula and the ingredients are mixed in the conventional type of pug mill used by highway contractors. The amount of asphalt added to each batch of coating represents about 14 per cent by weight, and the asbestos is stirred into the molten asphalt before adding the dry ingredients.

The several graded sands, the maximum particle size for the coarsest being ⅛ in. in diameter, are dried separately in the usual

Showing how new line at Estero terminal follows approximate contour of the hills to eliminate sags

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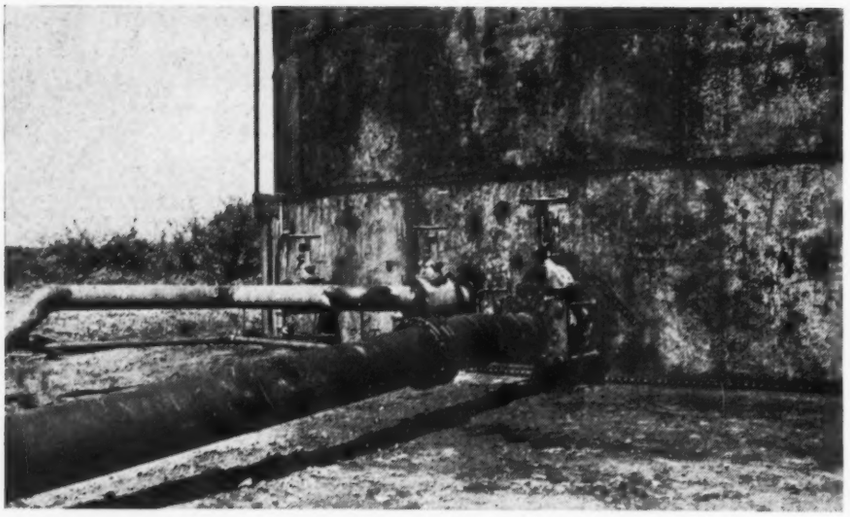
INTERNATIONAL TRUCKS



Gate valves on tanks at Estero terminal are made earthquake-proof by reinforcing both valve and tank shell with clamps of steel plate as shown

type of horizontal kilns and emerge at the hot discharge end at a temperature of about 450 deg. fahrenheit. A bucket elevator conveyed the hot sands to suitable overhead, insulated bins from which the materials flow by gravity into a weight box, where the mix ratios are measured. A similar scale bucket is used to weigh out the necessary amount of asphalt and asbestos fiber. The dry aggregates are first dumped into the continuously running pug mill, thoroughly mixed and then the asphalt and asbestos combination is added, followed by several minutes of pugging. With the completion of each batch the bottom sliding gate is opened and the heavy thick mastic, now at a temperature of about 420 deg. fahr. drops into a large storage hopper, from which it is discharged by a screw flight conveyor section.

An indicating thermometer having thermocouples in the hot sands, the mastic storage hopper, and the asphalt melting kettle are placed conveniently for the operator who weighs and mixes the mastic.

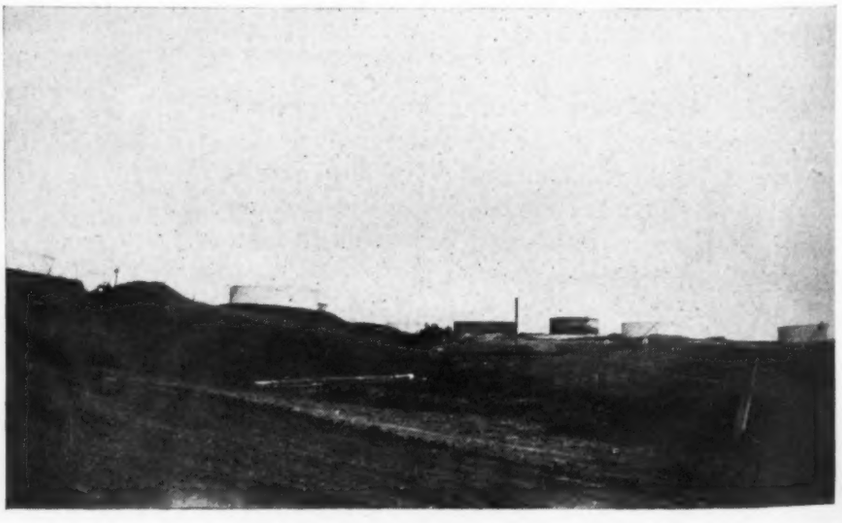
The flow of the mastic from the storage hopper to the equipment that applies the coating to the pipe is in turn controlled by a manually-operated gate valve. The pipe-coating equipment for the Rio Bravo-Estero line embodies a variable speed pressure pump that squeezes the mastic into a long, tapered, napthalene jacketed nozzle, through which the pipe is driven helically. A dense seamless coating of about 9/16-in. thick emerged with the pipe from this nozzle in a semiplastic state and at a temperature of about 400 deg. fahrenheit. Suitable pipe handling cars were used to engage and remove each 40-ft. joint of finished coated pipe while supporting the sections at each end. Just before the removal of the joint from in front of the nozzle, the ends were scraped clean of the already chilling mastic by means of a trimming blade device that was held against the still rotating pipe. The coated joints were then laid on end blocks that supported the pipe during the cooling and setting period of about 20 to 25 minutes.

As only about 30 miles of the Rio Bravo-Estero pipe line were to traverse severely corrosive soils, 78 miles were laid bare with no protection. The 30 miles of pipe, however, required about 1500 tons of sand, and about 1000 bbl. of asphalt. Concentrating expenditures for pipe line protection in those places where it is most needed has been found by the company to be more economical than placing a thin cheap coating over all the line and then reinforcing the protection somewhat at the most corrosive spots. In soils that show little or no corrosion, bare pipe will last so long that cheap coating will not provide any appreciable benefits; and in severely corrosive soils, anything short of the best coating is quite likely to deteriorate so rapidly that frequent replacement is necessary.

Laying of the reconditioned line presented no unusual difficulties, as pipe lines in California invariably cross mountain ranges and other types of rugged terrain. However, the new 12¾-in. line right-of-way crossed the San Andreas Fault, which is quite pronounced and has been known to change the ground conditions considerably when earth tremors occur. To provide a compensation for this fault, the pipe line was laid on the surface with a large swing, or back-up curve thrown in it to prevent breakage or rupture when earth movements occur.

When the pipe was laid from each station, new sections were placed on the discharge end that was expected to receive the most of the pump pressure, but none of the reconditioned pipe was such that any pipe line pressure could not be applied. As the line was built, each 40-ft. joint was connected by welding to the succeeding one, and the bare ends left uncovered by the protective coating applied to other portions of the joints at Kettleman Hills were coated in the field. Somastic mixed in the plant was melted down in portable field equipment and poured over the completed joints, which were covered with specially devised molds.

As the line proceeds northwestward, it comes to the right-of-way of the Kettleman-Estero pipe lines, one of which was built to carry crude petroleum, and the other handling natural gasoline manufactured in Standard Gasoline Company plants in that field. Both of these lines were laid in 1930. The crude line was constructed from 10-in. pipe, and



Partial view of tank farm at Estero

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the gasoline, or "white" line, of 8-in. pipe. All three lines run parallel from this point to Estero. The new 12¾-in. O. D. line and the 10-in. from Kettleman Hills enter the Shandon station, where pumping facilities have been provided to boost the oil in each, but using separate units.

Various types of crude produced from wells in the San Joaquin Valley will be transported through the new line, as well as heavy residuum from refineries near Bakersfield. When the lighter, high gravity oils are pumped under ordinary conditions, only three stations will be required, the initial station at Rio Bravo and two others. All the stations, however, will be required for pumping heavy Kern River crude, which also requires heating for transportation by pipe line.

The initial station at Rio Bravo, as well as the intermediate ones at Lokern, Middle, Bitterwater, Shandon, and Atascadero, and the transfer pumps at Estero terminal are operated by steam. Some of the stations have reciprocating pumps, while others are equipped with steam-turbine-driven centrifugal units.

At the Estero marine terminal, which was constructed in 1930 for handling of oil from Kettleman Hills, additional facilities have been added. Six steel tanks with a total capacity of 825,000 bbl. have been built on the hills above the coast. These tanks are connected to a 22-in. line leading to the shore and thence to an 18-in. submarine line extending about 3000 ft. offshore to deep water, where moorings are installed for tank vessels.

The original loading line laid from tankage on the hills on the coast ran in a direct line from the manifolds to the shore, crossing the ravines and hills with sags and overbends. The new loading line, however, has been laid around the rim of the hills and promontories so that no oil will be trapped in pockets and cause delays when changing from one product to another.

Both the old submarine loading line and the new one have almost identical control features at the shore, each being equipped with remote control gates where they pass a common loading house. The operator at this station has access to telephones from ship to shore as well as a series of ships' whistles to convey signals.

Both the submarine lines are equipped with special hose, which is connected by buoys so that a ship may upon mooring pick it up and attach it to the ship's lines for loading. These lines are quite widely separated so that two ships may maneuver and load at the same time without interference. Static head is great enough from the tanks on the hills to the ships at sea that each line can be used at a rate of about 15,000 bbl. per hour.

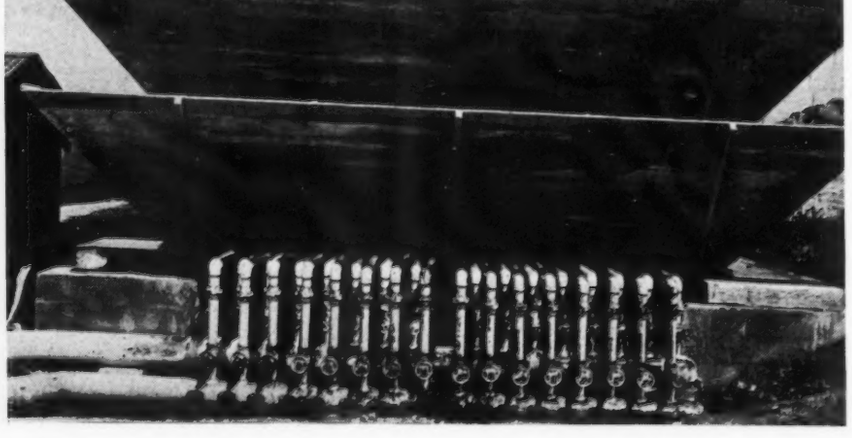
Special valves are attached to the ends of the loading hose and fitted with blind flanges when idle to prevent the loss of fluid from leaks. An automatic vacuum pump maintains approximately eight in. of vacuum on each loading line when idle, but is disconnected when oil flows through the lines.

Earthquake-proof gate protection was placed on all new tankage by building reinforcements to the gates flanged to the shells. Heavy plates of boiler steel were prepared by cutting holes in square sheets so that these reinforcing units could be slipped over the pipe and rest against the body of the gates. Holes were bored in each corner so that bolts could be inserted through the sheets to prevent separation of the gate bodies if severe stresses were placed upon them by earth movements.

An interesting feature in conjunction with the handling of natural gasoline from Kettleman Hills is the method used in cooling it as it is received through the 8-in. line. The mean temperature at Estero is about 66 deg. fahr., while temperatures at Kettleman sometimes reach 120 deg. fahrenheit. Gasoline leaving the storage tanks at the plants is under sufficient pressure to prevent evaporation, but if placed in large storage at Estero at the temperature at which it is received, excessive evaporation losses would be encountered. The gasoline has an initial boiling point of about 70 deg. fahr., and it is the desire of the company to store it at a temperature considerably below this point.

A conventional cooling tower was built on the hills near the line as it enters the tank farm and 2-in. pipe coils were placed in this tower through which the gasoline flows by pipe line pressure. In April the temperature of the gasoline being received at the cooling tower was considerably above the boiling point, but when it emerged from the cooling coils, the temperature had been reduced to 56 deg. fahrenheit.

When this gasoline is to be loaded in tankers bound for Richmond or El Segundo, it is moved through the 22-in. loading line used for other products. If heavy oil has been previously loaded in tankers, a special ship is used to receive the "off-colored" product. The amount of this "off-colored" gasoline depends upon the nature of the previously loaded crude, and the temperature of the sea water. Warm water and light crude provide a quick washing of the line to allow the loading of water-white gasoline.



Arrangement of coils for cooling gasoline at Estero terminal

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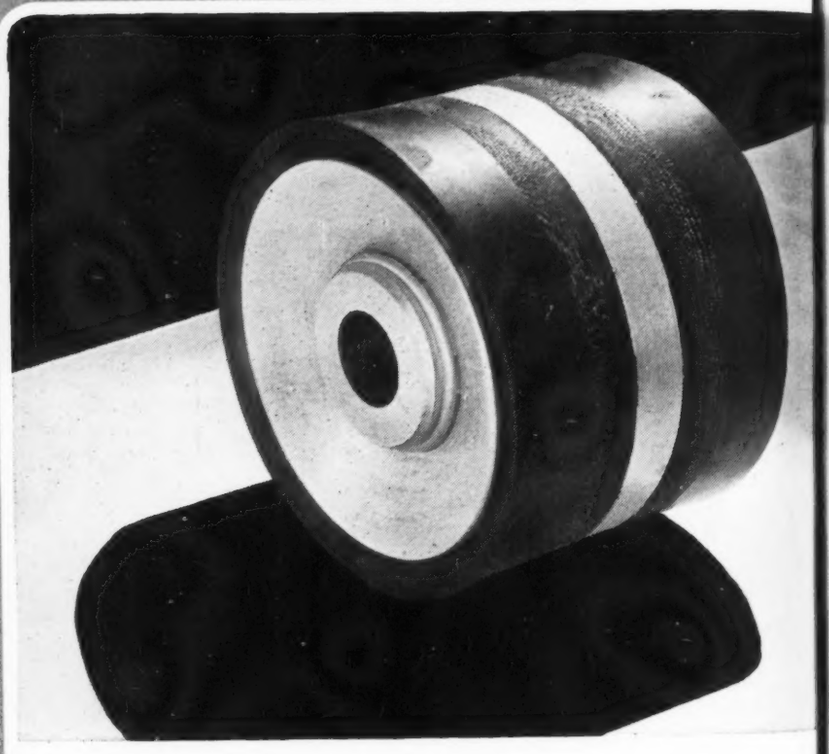

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Flow Line Treatment Now a Reality

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By

C. H. M. ROBERTS*

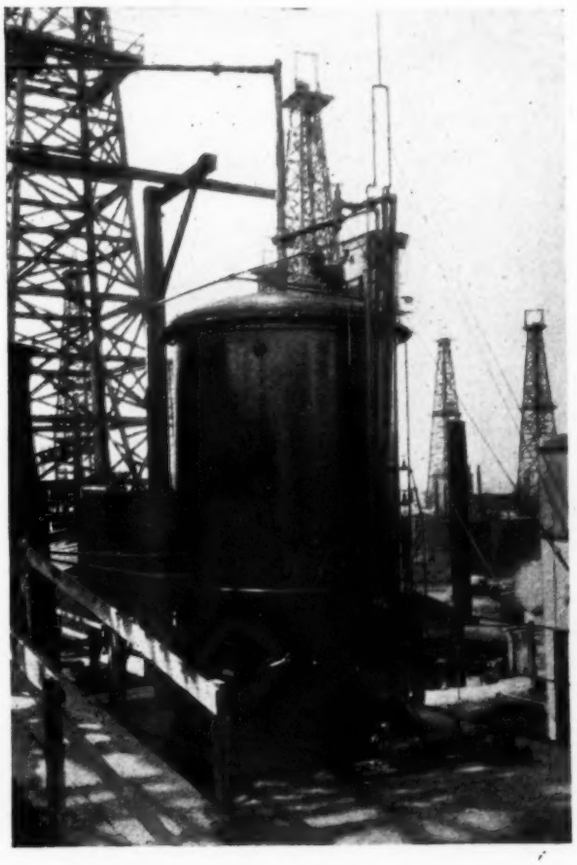
"FLOW LINE" treatment is the term applied to that system for electrical resolution of crude petroleum emulsions by the Petreco process, whereby the emulsified oil is conducted directly and continuously from the producing well into the dehydrator, where it is treated to pipe line requirements and from which it is delivered directly to dry oil stock. By use of this system of treatment, it has been possible to reduce materially the costs of dehydration, as well as to effect other economies, all of which accrue directly to the oil producer. Introduction of the flow line system of dehydration has been made possible through the research work conducted by Petreco for the benefit of its licensees, and is concrete evidence of the continued efforts of this company to perfect its process, and reduce it to the simplest possible terms and to the lowest possible cost. Despite the fact that flow line treatment has been in general use for less than a year, more than 70 such plants have been installed or converted from "batch treating" plants and additional installations are being made as rapidly as possible. In addition, practically the entire time of two test engineers, equipped with portable field test sets, is devoted to making flow line treating tests on wells in the Los Angeles basin district alone. Portable flow line test sets also are in use in other districts served by this company, and in the Houston (Texas) district there is a completely equipped, motorized, semi-plant scale field test unit. This unit is complete and self-contained, being equipped with its own electric generating plant, heater, pumps, and other auxiliary equipment. With this unit it is possible to proceed directly to any well or lease accessible by road, and conduct commercial treating tests, using either the batch or flow line system, under conditions practically identical with those encountered in full-scale commercial plants. This Mobile Treating Unit is being used for such field test work throughout the Gulf Coast and Mid-Continent areas.

Illustrations in this article show some of the new Electric Dehydrators developed to handle small volumes of "cut" oil.

That flow line treatment is not only a technical possibility, but a commercial reality, is due to the fact that the properties of emulsions and their response to electrical dehydration depend upon their age, history, and the character of handling to which they have been subjected. In other words, an emulsion is not a material whose properties can be measured once for all and tabulated for reference, as is possible with such definite materials as sodium chloride or other stable chemical compounds. Rather, an emulsion is analogous to a living being, which changes with time and in response to its environment and treatment. An emulsion taken from a sump or from the bottom of a storage tank is "old" both in time and in experience, and is "tough" as the result of its hard life. An emulsion taken fresh from a well is usually "young" and "easy" and more readily responds to treatment. The principle underlying flow line treatment, therefore, may appropriately be stated in terms of the old adage (somewhat modified to suit the case), "Catch 'em young and treat 'em *gently*."

Specifically, a crude petroleum emulsion is a system that is not in stable equlibrium, in which changes are continuously taking place, under the laws of thermodynamics, in an effort to reach that condition of equilibrium. Only two conditions of equilibrium are possible with an emulsion. In one, equilibrium is reached when the emulsion separates to continuous phases of oil and water. This, in reality, is the only thermodynamically stable equilibrium, toward which most emulsions tend but few reach. In the other, equilibrium is reached when the changes have practically ceased and the emulsion has attained a condition of maximum stability, in which condition it is capable of existing more or less indefinitely.

A petroleum emulsion, as we all know, is a system in which water or brine is dispersed in more or less minute droplets in the oil. But it is more than that. At the "interface", or boundary zone between the oil and water, there is a material known as the "emulsifying agent" upon whose presence the permanence and properties of the emulsion depend. It is in this interfacial zone that the changes mentioned above occur. The source of the emulsi-



The largest of the small units to be constructed; size 6 ft. diameter by 10 ft. high

*Director of Research, Petroleum Rectifying Company of California.

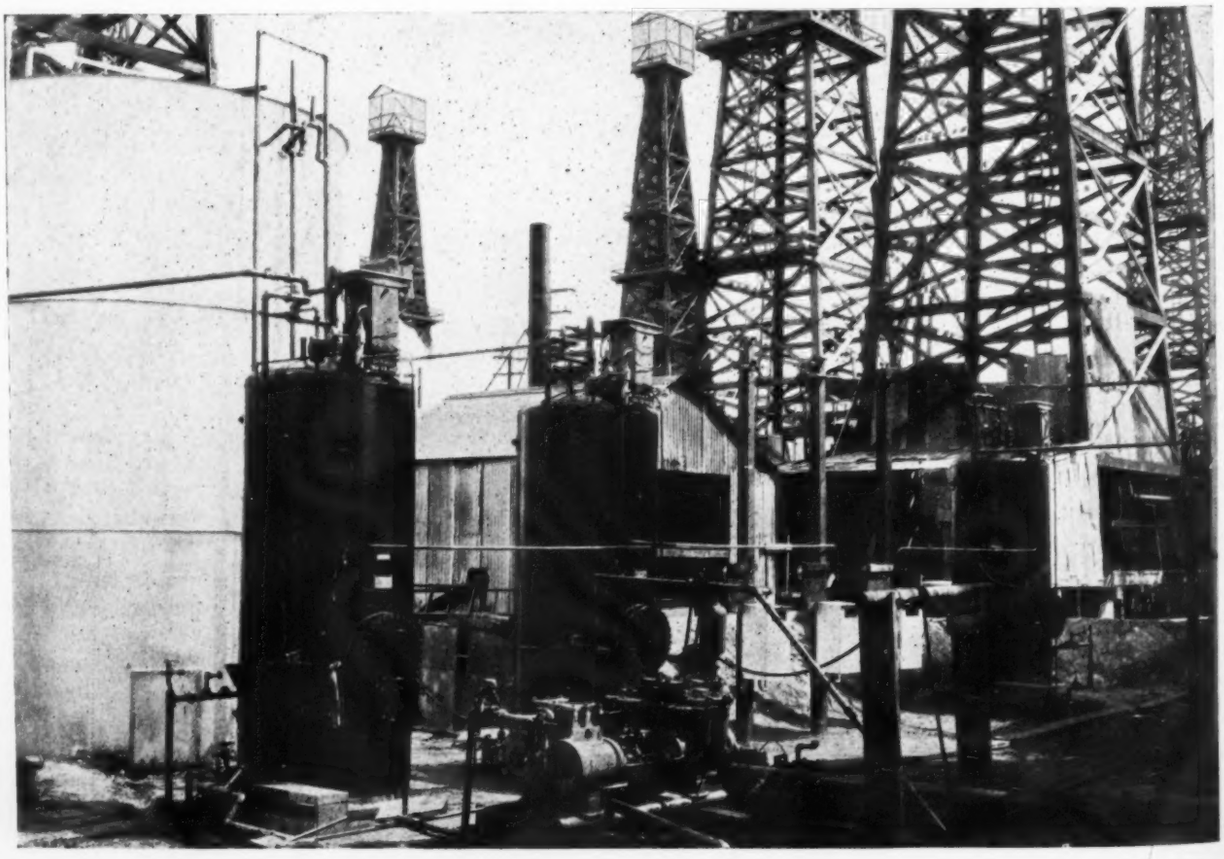
fying agent may be in the oil or brine, or both, and this material is a naturally occurring component of the phase in which it is present. Unfortunately, the "emulsifying agent" is not a single material as its name implies, but may be any one or a number of materials, differing in chemical structure, physical properties, and activity, but possessing the common attribute of congregating, or "adsorbing", at the oil-water interface. Most emulsion problems are due to the variety and variability of these emulsifying agents, and the differences in their properties.

Since the emulsifying agents are components of the oil and/or brine, and since they adsorb at the interface when the brine is dispersed in the oil, it is apparent that they must migrate from the interior of the oil or brine to that interface; and this takes time. Since the various components of the emulsifying agents have *different* properties, it is clear that the time required for this migration will vary in each instance. The differences in the response of "old" and "young" emulsions to dehydration depend in part upon these time factors.

Since time is a factor inseparably connected with the stability of an emulsion, it is important that we consider the *age* of the emulsion but age must be understood to mean, not *how long* the emulsion has existed, but how long *in comparison to the time required to reach maximum stability*. In other words, of two emulsions, both two hours "old" according to the clock, one may be still a mere infant while the other is already as old as Methuselah, in terms of stability and resistance to treatment. Hence it is obvious that all emulsions will not be equally susceptible to effective flow line treatment, in which the underlying principle is dehydration with the least possible *time* delay after production.

In addition to the age of an emulsion, we must also consider its history before it is delivered to the dehydrator for treatment. It is common knowledge that emulsified oil, as it is produced, is usually warm and may be quite hot, also that it contains considerable fixed gases in solution, as well as more or less light gasoline fractions. When pumped into a tank and stored for some time before being treated, the emulsion naturally cools off and loses some of or all the dissolved gases and light ends. Due to these losses, as well as to its greater age when finally treated, the emulsion frequently becomes considerably more resistant to dehydration, must sometimes be heated to a relatively high temperature, and may even require chemical aid in extreme cases, in order to produce pipe line oil. In addition, as is well known, emulsions often stratify during storage, so that the material in the lower

A three-unit flow line installation in service at Signal Hill, Long Beach, California. Space available was too small to permit installation of the standard 10-ft. dehydrator tank, and too restricted for the regulation switchhouse. As a result, a new type of switchbox was developed. The units are 5 ft. diameter by 10 ft. high, and each one is handling production from a different lease.



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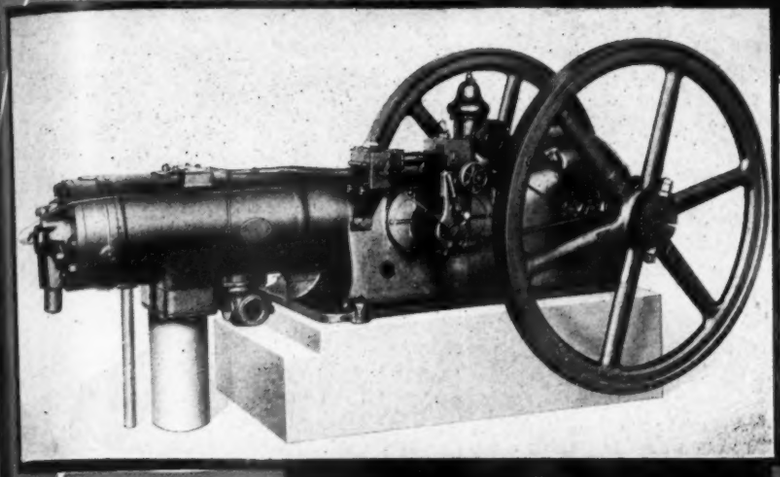

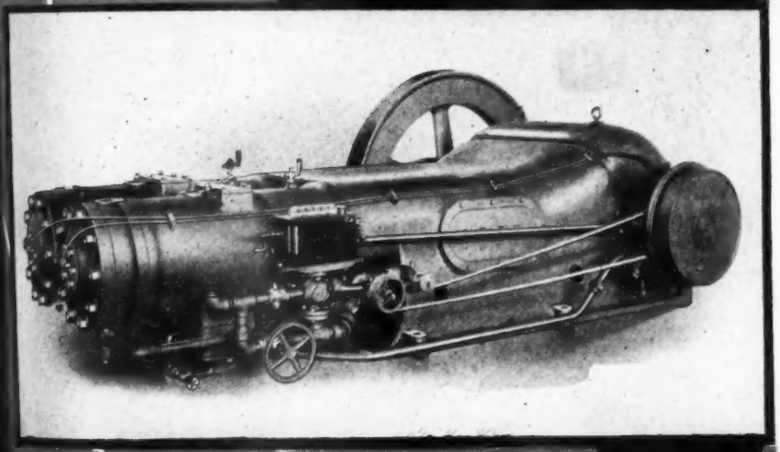

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13 x 18	"	"	50	70
14 x 18	"	"	60	85
11 x 15	Twin	"	75	100
12 x 15	"	"	100	120
13 x 18	"	"	140	140
14 x 18	"	"	170	170

OIL

			Oil Field	Commercial
11 x 15	Single Cylinder		30	45
12 x 15	"	"	40	55
13 x 18	"	"	50	65
14 x 18	"	"	60	75
11 x 15	Twin	"	75	90
12 x 15	"	"	100	110
13 x 18	"	"	130	130
14 x 18	"	"	150	150

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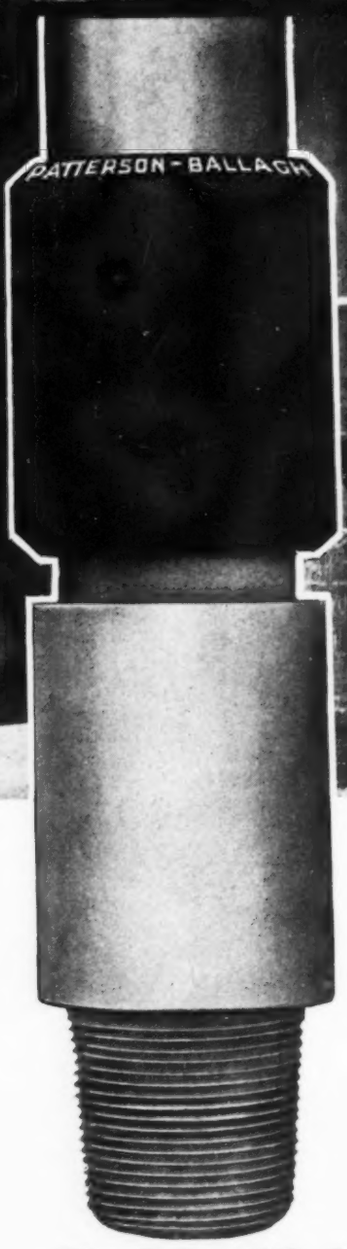

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portion of a tank contains a high percentage of emulsified water, while that in the upper portion contains relatively little, although more than pipe line requirements permit. This stratification causes additional difficulties in dehydration because the sludged emulsion may be too wet, while the top oil may be too dry, for the most effective treatment in a dehydrator designed to meet "average" requirements. Even if such extreme conditions as these do not exist, the mere fact that the water content is continually changing introduces difficulties in regulation and necessitates more or less continuous supervision of the dehydrator.

Flow line treatment overcomes all these disadvantages, since the emulsion never is permitted to come into contact with the air, nor to stop moving, until *after* it has been dehydrated and delivered to stock. The naturally contained heat is not permitted to be dissipated in cooling—only to be replaced at a cost to the producer. Instead, it is conserved and utilized in treating. With many emulsions, it is possible to treat with entire success at the temperatures at which they are produced. With others, it is necessary to supplement the natural well temperature, but, in most cases, this can be done at much less cost to the producer than is possible under the "batch treating" system, as will be described subsequently. In any event, a net saving equivalent to reheating the oil from tank temperature to well temperature is made.

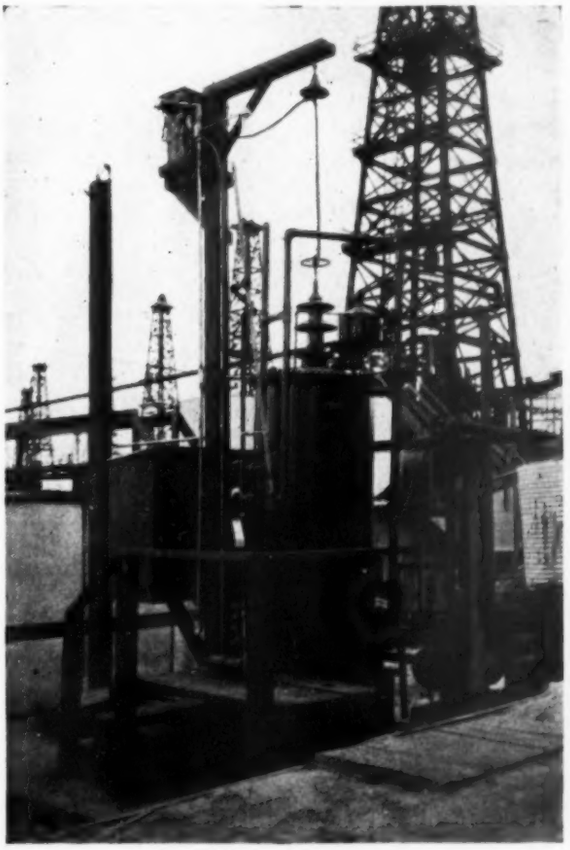
A further material saving with flow line treaters arises from the fact that, since treating temperatures usually are much lower than under the "batch" system, the gravity and gasoline losses that may occur in the latter system unless heat exchangers, cooling towers, or other devices are employed, are almost or entirely avoided. This operates to the further advantage of the producer in two ways; by avoiding considerable installation and maintenance expense for such equipment, and by conserving the quality of his treated oil so that it commands a higher price. A still further saving to the producer employing flow line treatment lies in the elimination or material reduction of chemical aid requirements, sometimes necessary under "batch" treating methods. In some cases this chemical expenditure constitutes a considerable proportion of the total cost of dehydration under the "batch" system.

By conducting the emulsified oil directly from the well to the dehydrator, which is the essential feature of the flow line system, it is obvious that no stratification or sludging can occur and that the "average" emulsion is delivered continuously to the dehydrator. This contributes materially to the efficiency of the process, since it permits the dehydrator to be more closely adjusted to the conditions existing, with consequent improvement in its efficiency of operation. This reacts directly as a saving to the producer by eliminating the necessity for re-runs and re-circulation, and by keeping the dehydrator at all times at its highest efficiency and lowest power consumption. In addition, since the treater is operating on "average" oil at all times it requires a minimum of supervision, which permits a considerable saving in labor costs chargeable to dehydration. Also, as will be discussed subsequently, certain design changes have been incorporated into flow line treaters so as to make them full automatic in operation, requiring only nominal servicing and inspection. It is therefore seen that, by substituting flow line for "batch" treatment, it is possible to alter completely the history of the emulsion prior to treatment; and that each factor in this alteration contributes to increasing the efficiency and decreasing the cost of dehydration.

The difficulties due to the manner of handling the emulsion prior to treatment have been almost completely eliminated by introduction of the flow line system. To accomplish this under the most favorable conditions, this company has designed new types and sizes of dehydrators and auxiliary equipment suitable for installations in direct connection with the well, and new types of heaters and controls have been perfected where additional heat is necessary or desirable.

A number of different types of automatically controlled water-bleed valves are now being developed and tested in order to determine the type best suited for use with flow line treaters. The familiar "siphon" bleeder or "swing", often used on gun barrels and wash tanks, also has been satisfactorily adapted to electric dehydrator requirements in many instances. The valves under development include types operated mechanically, hydraulically, and electrically, and from these a type will be chosen whose cost, operating characteristics, and dependability will meet the high standards that have been set.

The electrical equipment used with flow line treaters has been re-designed to lower its cost and improve its accessibility and operation. This change has taken the form of an entirely new and improved switchboard, housed in a weather-proof steel box and mounted on the pole supporting the power line,



Smallest of the new units placed in operation; size 3 ft. diameter by 6 ft. high.

in a convenient position near the dehydrator. This replaces the old-type switchboard, housed in a galvanized iron switchhouse, and supplies a more accessible, useful, and materially cheaper piece of equipment. The transformer, as previously, is mounted in a safe position on top of the treater, and the high voltage is delivered to the electrodes within the treater by means of an improved porcelain-top bushing of the type now standard for all plants. The electrodes employed in flow line treaters are of the improved CR type recently developed and now in wide and successful use. This type of electrode offers particular advantages in that the intensity and distribution of the electric field are especially favorable to flow line treating, its normal current demands are exceptionally low, and it lends itself to easy and accurate adjustment, which is maintained practically indefinitely. The distributor used in flow line treaters, through which the incoming wet oil is directed into the electric field, has been specially designed for the purpose of handling the relatively large volumes of free water that frequently accompany the oil as produced and that, in flow line treatment, are passed directly into the dehydrator. Due to the distributor design, this free water is prevented from reaching and short circuiting the electrodes, which, if permitted, would increase power demands and decrease treating efficiency.

Finally, the dehydrator tank itself has been redesigned, both to meet A.P.I. code requirements and to provide a more economical and efficient unit for flow line work. To meet the latter requirements, experimental treaters three ft. in diameter by six ft. high, four ft. in diameter by eight and one-half ft. high, five ft. in diameter by ten ft. high, and six ft. in diameter by ten ft. high, have been built and tested and are in successful commercial operation. One or another of these experimental dehydrators has proved to be especially suitable for wells having individual production characteristics; however, for simplicity, standardization, economy in production, and general utility, the 5-ft. treater has proved most suitable, has been adopted as a tentative standard, and is now in production. Its use permits the most generally economical plant, suitable for wells or leases of up to about 400-500 bbl. per day. In addition, the standard dehydrators (10 ft. dia. x 12 ft. high) are available for larger wells and leases, and for producers, already equipped with dehydrators, who desire to convert their "batch" plants to flow line plants.

The only additional equipment that may be required with a flow line plant is the heater. Since the temperature requirements for flow line treating are usually notably lower than for batch plants, the heater may be of very simple form and construction, and adapted to utilize the waste heat available on many leases. An especially favorable form of heater is one that utilizes the waste heat from circulating water used in cooling the pumping engines, or waste heat from the exhaust gases of such engines. Automatic temperature controls are not required with such heaters since, if the well is shut down, the heat also is shut off. Heaters of these types may be constructed at negligible expense and their cost of operation and maintenance is practically zero. Other types of heaters may employ steam, if available, and may be cheaply constructed on the lease; or may be of the types standard for prior Petreco dehydrators. The latter types also may be used efficiently with gas engine circulating water. If neither sufficient waste heat nor steam are available, any one of a variety of simple but efficient direct-flame heaters may be employed. The simplest of these takes the form of two concentric pipes, the inner of which is the lead line carrying the fluid to be heated, while the outer is a piece of casing, with a stack at one end and a gas burner in the other. The gas requirements and cost of operation of such a heater are relatively low. If production conditions warrant, a more elaborate heater such as the familiar boiler-type heater may be employed, and this is a highly satisfactory and efficient piece of equipment.

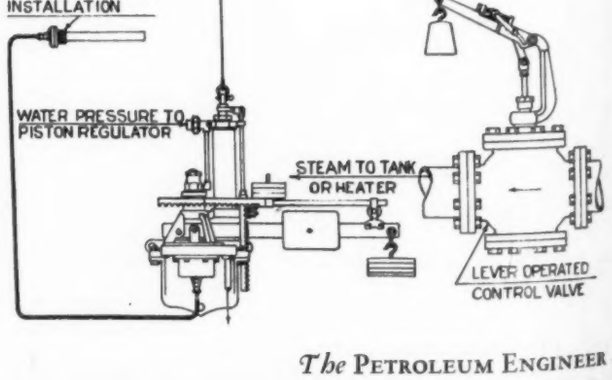
With whatever type of heater employed, if the heat source is other than the engine circulating water or exhaust gases, a suitable type of temperature regulator should be used in order to conserve fuel, enable maintenance of a suitable treating temperature, and to shut off the heat if the well goes down. Such regulators can be obtained at moderate cost and in sizes to suit any lease requirements.

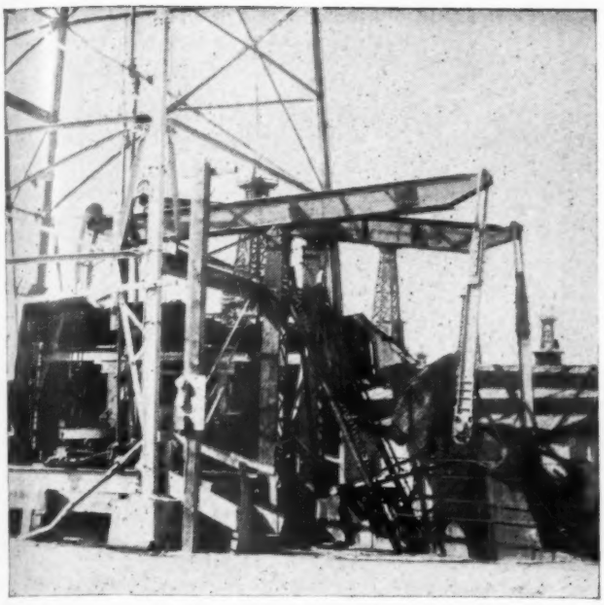
The foregoing discussion has been concerned with the latest type of equipment, which has been developed to meet flow line treating requirements. There are many producers, however, now equipped with older types of dehydrators of this company, whose emulsified oil will respond most favorably to flow line treatment and whose equipment may be easily converted from "batch" to flow line operation at negligible cost. The results to be expected may be determined by field testing equipment before any change is made.

Controlling Large Steam Line

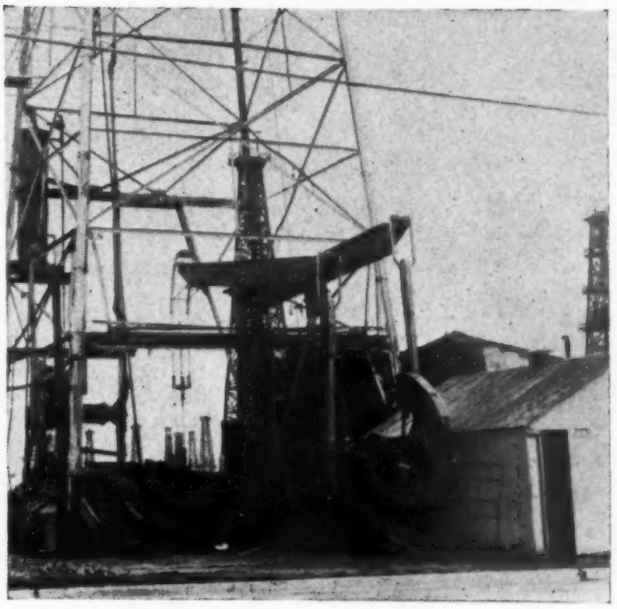
By W. F. SCHAPHORST

ATTEMPTS to handle a steam valve as large as eight inches, temperature regulation alone, without the aid of water or air pressure, usually result unsatisfactorily. An intermediate power device, such as shown in this sketch, is generally advisable. Place the regulator bulb in the tank or heater. It controls the hydraulically-operated cylinder shown in the center, which in turn opens and closes the lever-operated control valve through the wire cable as shown. This is a dependable method which assures temperature regulation within close limits.


REGULATOR BULB FOR TANK OR HEATER INSTALLATION
WATER PRESSURE TO PISTON REGULATOR
STEAM TO TANK OR HEATER
LEVER OPERATED CONTROL VALVE



Two separate wells in Signal Hill field under one derrick and pumped by one engine



Note the arrangement of the pumping equipment with respect to the engine

Two Wells Drilled Five Feet Apart at One Location . . . Now Pumped by One Engine

FOR the sake of economy in both drilling and producing operations, Ben F. Munn, an independent producer of Long Beach, recently drilled, and is now pumping with one engine, two wells from one location in the Signal Hill field, California. The location at 32nd and Atlantic Ave. is Goetz No. 23 and the production from the two wells is different in gravity and quantity, each hole being completed in a different producing zone. The conditions in this area are favorable to this method of completion and, since the successful drilling and production of these two wells, five more similar operations have been commenced by various companies, in addition to another one by B. F. Munn on another lease.

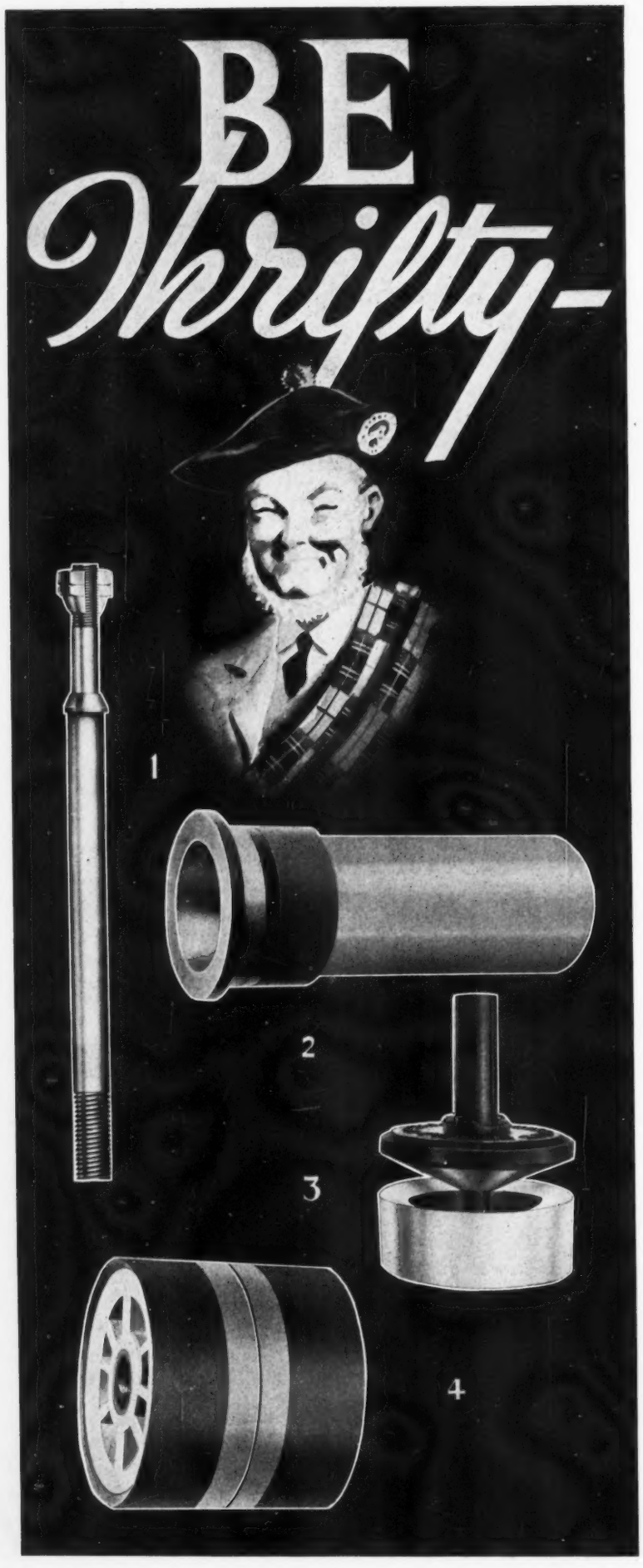
The two wells are five ft. apart at the surface. The first well was drilled to a total depth of 4500 ft. and a 7-in. water string set and cemented at 4250 ft. with the cement extending up behind the casing for about 2500 feet. A string of 5-in. liner was run to bottom and the well put on production through 2½-in. tubing. Considerable care had to be taken to keep the well as nearly vertical as possible so as to avoid possible interference later when the second well would be drilled. Survey readings were therefore taken at frequent intervals during drilling and the measurement of both inclination and direction made with a single-shot instrument was used to plot the entire course of the hole.

The second well was drilled while the first was on production. The rig was first skidded five ft. with the location of the second hole determined by the derrick V so as to permit the handling of pipe during the drilling operations. This hole also had to be kept as nearly vertical as possible and by taking reading of the inclination and direction at regular intervals, it was prevented from intercepting the first well. At one point, the second hole came within three ft. of the first, but this was the closest that the two wells ever came to meeting.

The total depth of the second well is 4950 ft. and the zone from which production is being taken in the first well was cemented off with the string of 7-in. casing. A 5-in. combination string was run and cemented above the lower producing sand and 2½-in. tubing run in for production. The rig was then skidded back only 2½ ft. so that both wells can be serviced or repaired with the least amount of trouble.

As shown in the illustration, both wells are being pumped with one engine. It has been found that the one engine operates more smoothly and with less jerking than is usually the case when only one well is being pumped. Although one well is in the third hole and the other in the second, there is a balance that seems to promise a considerable reduction of crystallization and the elimination of trouble by unnecessary stress and strain.

The power is supplied by a 50-hp. gas engine with fuel taken from a domestic gas line. The wells have been in operation for six months and have not yet been touched. Less fuel and less power have been required than when pumping one well of similar size and depth in the same area.



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MacClatchie equipment is the result of exhaustive research and field tests and fills a real need in drilling oil wells. The MacClatchie name on any specialty is your assurance of Quality—Simplicity and Efficiency. Most operators are familiar with the satisfaction and savings derived from the use of MacClatchie Mud Pump Valves and MacClatchie Pistons. Comparable savings are derived by the use of MacClatchie Pump Liners, Valve Seat Pullers, Pump Liner Pullers and Piston Rods. Increase your savings and satisfaction by ordering all your equipment for slush pumps from MacClatchie.

1. MacClatchie Special Taper Rod—A Universal rod with a rod nut of such taper and so designed as to automatically tighten on the rod threads and insure a firm grip on the piston. It also insures an effective fluid seal and the proper amount of metal contact to withstand hard usage encountered in high pressure drilling. The rod nut can be readily loosened when desired, thereby eliminating all difficulty in removing the piston from the rod.

2. MacClatchie "Money Saver" Pump Liners—Quickly and economically replaced when worn. Made of special alloy seamless steel, hardened and ground to mirror-like finish.

3. MacClatchie Mud Pump Valves—The world's largest selling valve. Made of drop forged steel. The seats are accurately hardened and ground, wrapped in oil paper and individually sealed in heavy cartons. Cutout mud ends are unknown to users of MacClatchie Valves. Made in over 90 styles and sizes for every make of pump.

4. MacClatchie "Wearever" Pump Pistons—Designed so that wear is absorbed by the rubbers which are economically replaced for less than half the cost of a new piston. All bodies are machined from drop forged steel. They do not break. Made for all sizes and makes of pumps, for taper or universal rods.

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COMPTON, CALIF. HOUSTON, TEXAS

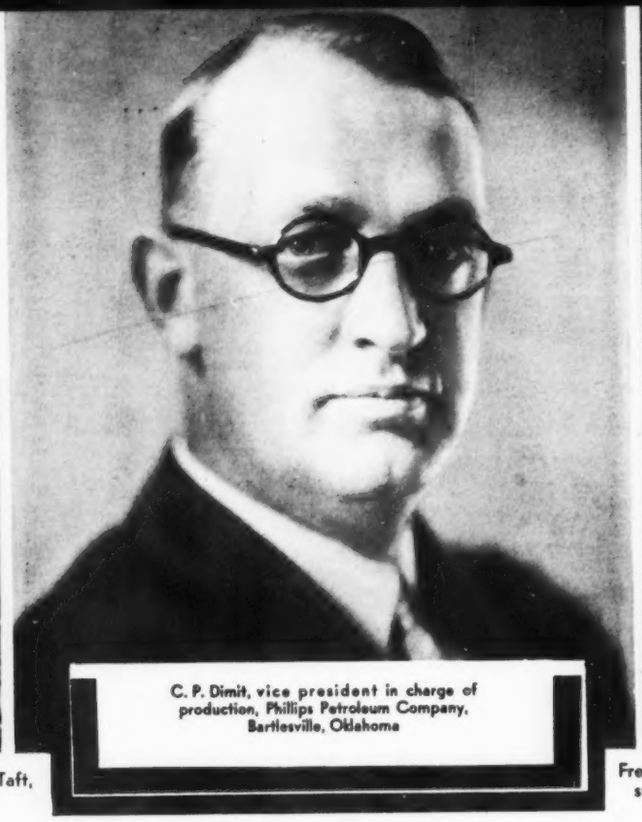
JUNE 1935

Pictorial Petroleum

Gun-perforating a deep well; the Associated Oil Company's Lloyd No. 40, Ventura Avenue field, California

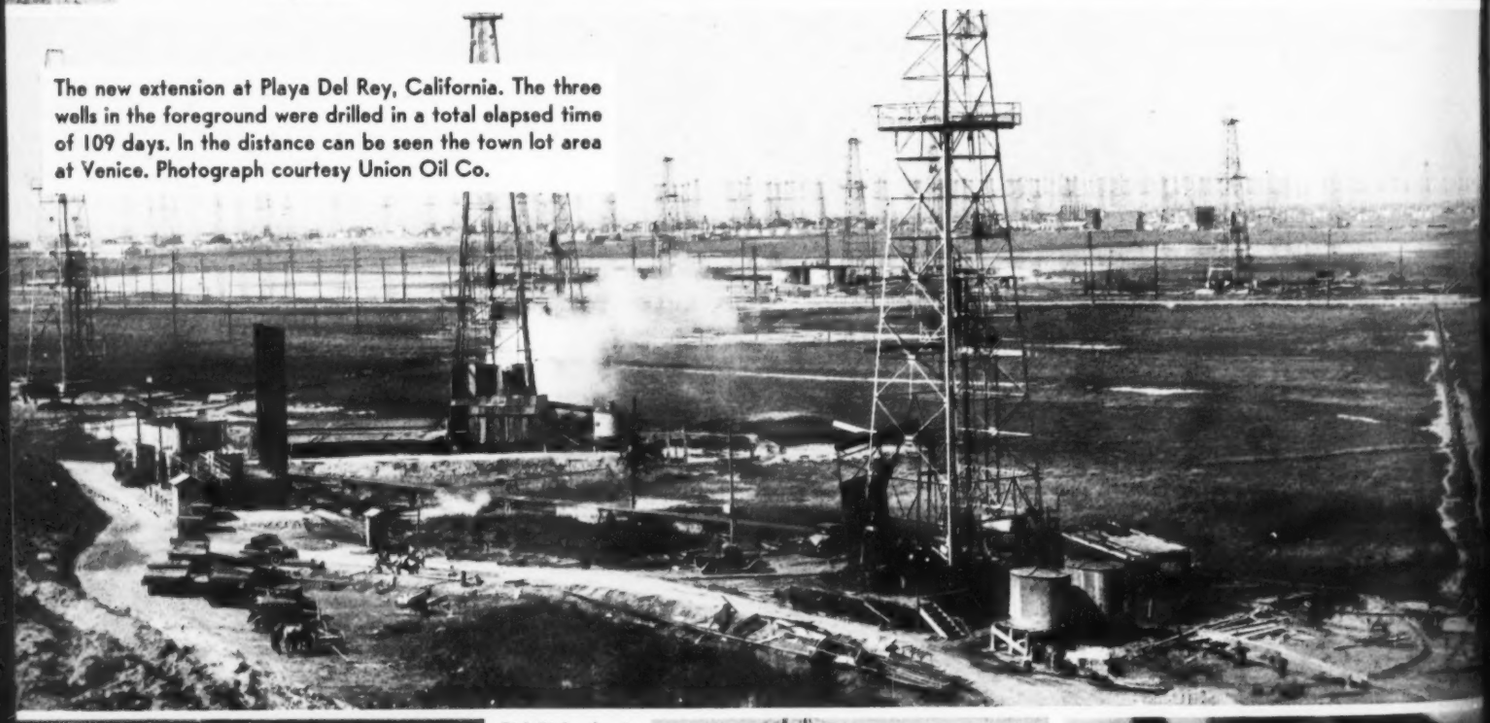
A Regular Feature of The Petroleum Engineer

R. R. Shinn, general superintendent at Taft, California, for General Petroleum Corporation



C. P. Dimit, vice president in charge of production, Phillips Petroleum Company, Bartlesville, Oklahoma

Fred W. Dallas, Houston, Texas, general superintendent for Pure Oil Company's Gulf Coast Division



The new extension at Playa Del Rey, California. The three wells in the foreground were drilled in a total elapsed time of 109 days. In the distance can be seen the town lot area at Venice. Photograph courtesy Union Oil Co.

Left—H. S. Moore, field foreman for Gulf Production Company at Houston, Texas

Sid Richardson's J. B. Walton No. 1 well situated 5 miles east of the Sayre pool in Winkler County, Texas. This promising wildcat is now drilling

J. H. Cuthrell, petroleum engineer with the Humble Oil & Refining Company, Houston, Texas

Prevent Blow-Out

No well has ever blown out while Hydril Pressure Drilling Equipment was in use. The balanced combination of Hydril external flush joint drill pipe, drilling packers, slips, snubbing device and hydraulic rotary is automatically operated by the well pressure to guard against dangerous emergencies.

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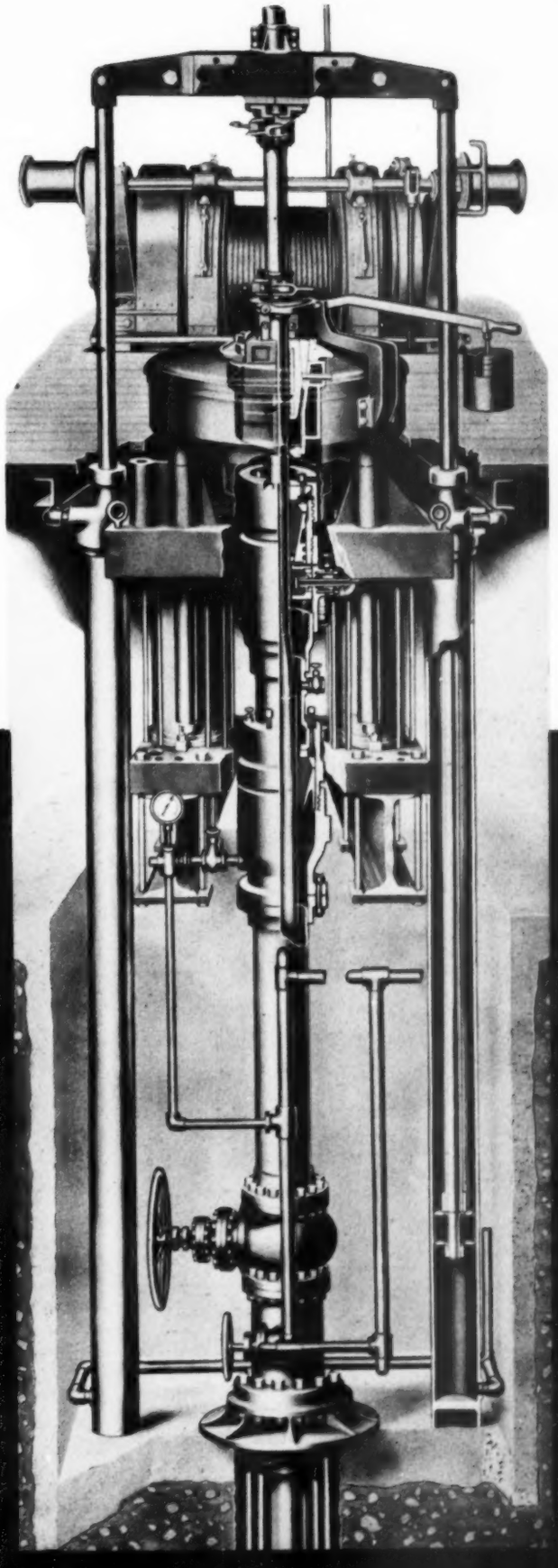

The equipment pictured here enables you to drill with safety against the highest pressures—to protect pay zones of normal pressure from injury due to penetration by drilling fluid—to keep low pressure wells alive by allowing them to flow while drilling.

Insure the protection of lives and property—the conservation of natural resources—the speed and economy of your drilling operations with Hydril Pressure Drilling Equipment.

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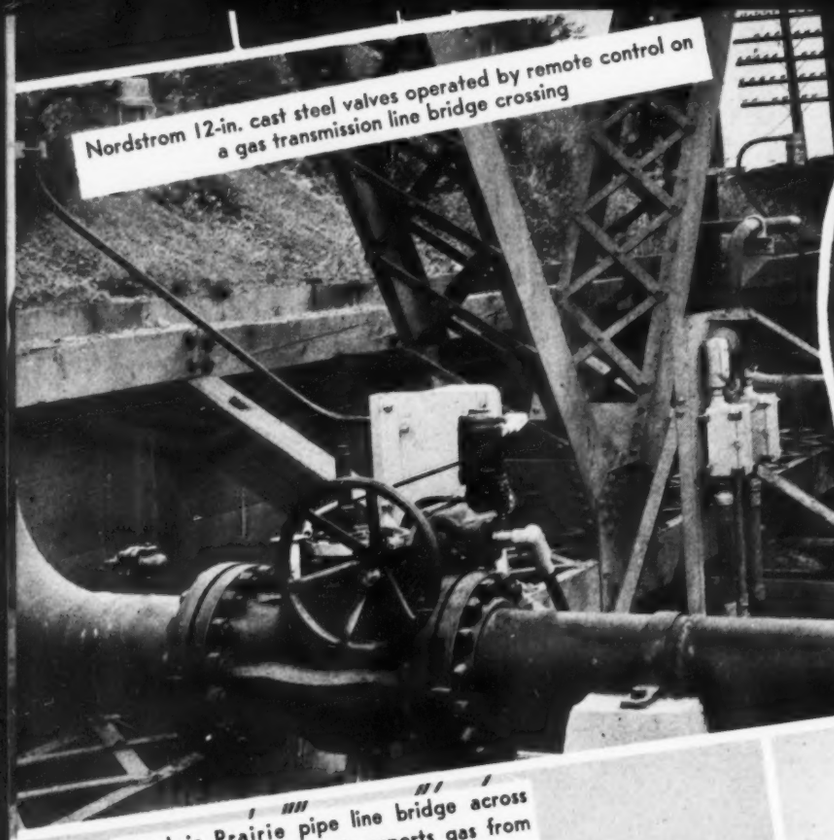
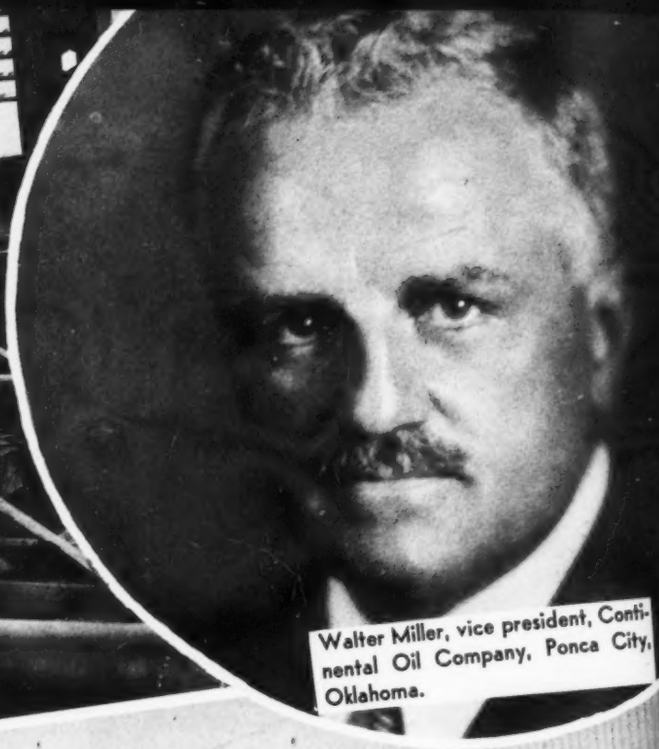


Nordstrom 12-in. cast steel valves operated by remote control on a gas transmission line bridge crossing



Walter Miller, vice president, Continental Oil Company, Ponca City, Oklahoma.

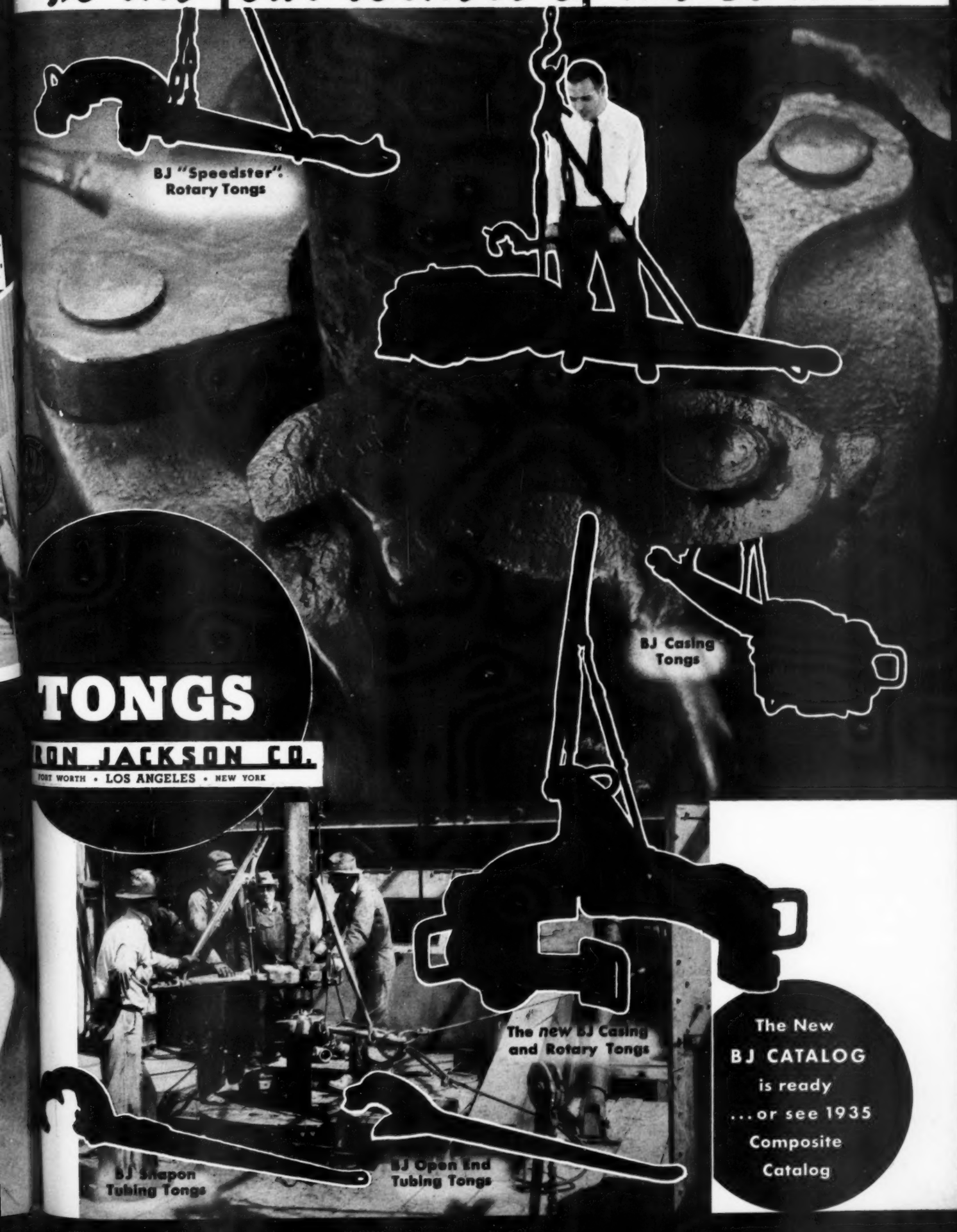
Sinclair Prairie pipe line bridge across Sabine river. The line transports gas from the Cole leases to plant No. 18 Camp Switch, East Texas.

Left to right: Charles Hinderliter, M. B. (Tommy) Thompson, L. E. Klinger, with Hinderliter Tool Company, and E. E. Lambert, West Texas representative of A. Leschen & Sons Rope Company.

Carl C. Joys, Jr., sales manager, A. O. Smith Corporation, Milwaukee, Wisconsin.

STANDARD

To the four corners of the Earth!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The new BJ Casing and Rotary Tongs
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TONGS

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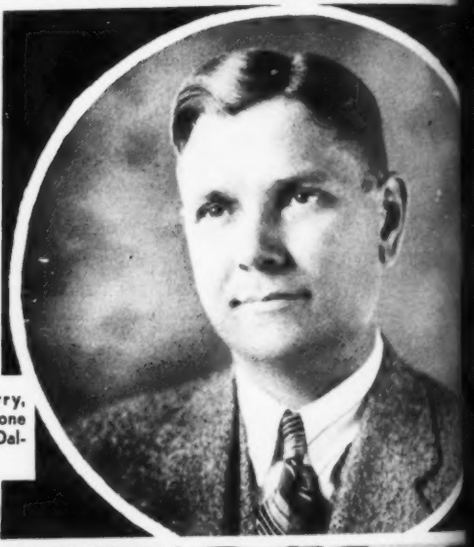
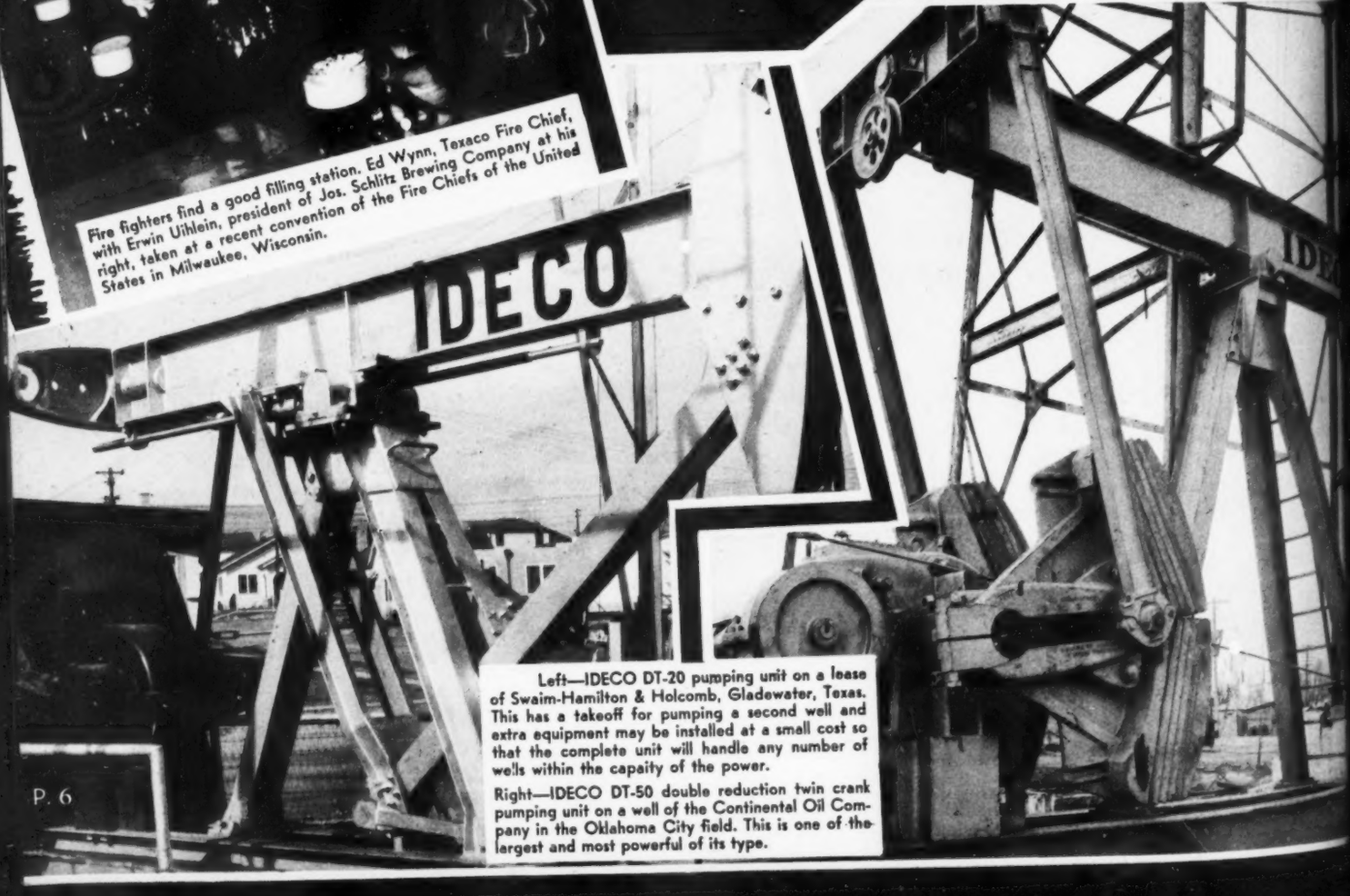
Above—Affected by recent promotions within the organization of Baash-Ross Tool Company, Los Angeles, California, were the three men shown above. Erwin Burns, vice president (left) was elevated to the position of general manager and will continue as assistant to L. F. Baash, president; John B. Schuyler (center) was made a vice president and will act as special sales representative; H. C. Ross (right) was appointed sales manager.

Fire fighters find a good filling station. Ed Wynn, Texaco Fire Chief, with Erwin Uihlein, president of Jos. Schlitz Brewing Company at his right, taken at a recent convention of the Fire Chiefs of the United States in Milwaukee, Wisconsin.



Right—B. B. Newberry, purchasing agent of Lone Star Gas Company, Dallas, Texas.



Left—IDECO DT-20 pumping unit on a lease of Swaim-Hamilton & Holcomb, Gladewater, Texas. This has a takeoff for pumping a second well and extra equipment may be installed at a small cost so that the complete unit will handle any number of wells within the capacity of the power.

Right—IDECO DT-50 double reduction twin crank pumping unit on a well of the Continental Oil Company in the Oklahoma City field. This is one of the largest and most powerful of its type.

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[1]

[2]

[3]

1. Engineer Alberto Mendez Casariego, director of Yacimientos Petroliferos Fiscales.

2. Well blowing wild, Lake Maracaibo, Venezuela.

3. Engineer Mario Z. Villa, also director of Y. P. F., which company carries on extensive operations in the Argentine Republic.

4. View showing the expert planning of a terminal at Lagunillas, Venezuela.

5. A number of producing wells of the Yacimientos Petroliferos Fiscales, Comodoro Rivadavia.

[4]

[5]

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- LIFTER SUB of heat treated alloy steel.
- OUTER BARREL. Made of heavy internal upset tubing or A.P.I. drill pipe depending on size.
- CIRCULATION CLEARANCE combined with ample strength.
- VALVE SEATS and BALLS are made for long, hard service.
- VALVE is locked to inner barrel while coring.
- THE FLOATING INNER BARREL has smooth interior and no threads are used in assembly.
- BREAKING THIS ONE JOINT disassembles the barrel.
- CIRCULATION is directed to cutting teeth without washing core.
- DOG TYPE CORE CATCHER floats with inner barrel, and does not scrape core.
- CORE HEAD cuts fast, full-gauge cores of large diameter.

Now you can secure large, complete cores from any type of formation!

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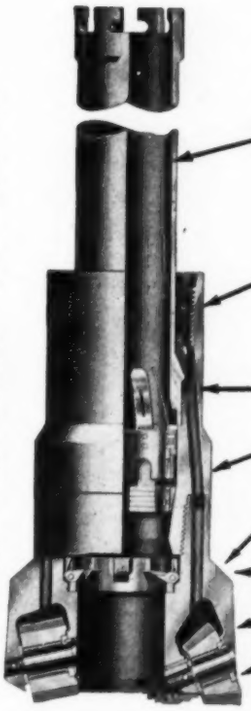
FAST, SAFE, LOW-COST CORING

You can know positively whether the sands being penetrated are oil-bearing, water-bearing or dry. You can know the exact thickness of productive sands. You can know where to make a water shut-off. You can know where breaks in the sands occur, and where to set your casing. And you can secure all this information with little loss of time—with complete safety—and at a cost which may be disregarded when the many benefits and profits of good coring are considered.

IT PAYS TO CORE WITH AN ACE IN THE HOLE

Many other modern advantages are secured when you use Globe Coring Equipment—developed by practical men after years of experience and based upon the ideas and improvements suggested by oil operators, engineers and geologists.

Submit your coring problems to us for recommendations and prices or see your 1935 Composite Catalog for details of GLOBE Profit-Making Equipment.



features of GLOBE Type "KR" ROCK CORE BIT

- INNER BARREL "floats" on special bearing to prevent excessive wear.
- CORE HEADS easily adapted to fit other Globe or Globe-Smith coring outfits.
- CIRCULATION AREA directs fluid to rollers without washing action on core.
- SLIP CORE CATCHER positively pulls the hardest cores, and is of strong, safe construction.
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- A Study Course for Field and Plant Men
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W. L. NELSON
K. C. SCLATER
Editors

Elements of Applied Petroleum Production

By K. C. SCLATER

Article 20

CENTRAL PUMPING POWERS (Continued)

CENTRAL powers for pumping groups of wells are becoming of increasing importance in field practice. Wells are pumped from a greater depth today than ever before. Efforts are being made continuously, on the part of both the manufacturer and the operator, to improve performance and thus obtain a higher standard of efficiency.

Central power design and the performance obtained in central power pumping operations are subjects of engineering analysis. Two papers of interest in this connection have appeared very recently. One discusses the system of transmitting power pneumatically to wells from a central power.[83] The other paper discusses the conventional type of central lease power and equipment, and the backside-crank arrangement by which two or more wells are pumped from one prime mover.[84]

PNEUMATIC SYSTEM FOR MULTIPLE PUMPING[83]

"The pneumatic pumping system is an improved method of actuating sucker-rod pumps by the direct application of the energy of a compressible fluid to the polished rod through the medium of a specially designed cylinder suspended above the well and directly connected to the upper end of the rod string. The complete system consists of a single-stage air compressor as the source of power with its driving unit, pipe lines for conducting the compressed fluid to and from the well, preheaters at the wells, and control valves for maintaining the proper operating pressures.

"One or more wells may be operated from a single compressor, group of compressors or high-pressure gas wells. Where gas-lift plants are already installed it is often only necessary to lay return lines from the wells to the plant and install control valves." One such single compressor is "equipped with a two-purpose single-stage cylinder in which the head end performs the function of circulating the air in the system boosting from the downstroke pressure to the upstroke pressure required for the pneumatic cylinder operation. The crank end of this same cylinder, also single-stage, compresses from atmosphere directly into the intake of the circulating end the necessary quantity of make-up needed to replenish that lost from the system by leakage. The quantity handled by either end can be varied within limits to meet pumping conditions. One cylinder of this type, either on a single unit or in a group of compressors, will take care of the make-up requirements.

"The discharge from the compressor at the required pressure is conducted by pipe lines to the well or wells in the system where it passes through the preheater, raising the temperature and increasing the volume before entering the pumping cylinder. The pressure, being of a value sufficient to raise the weight of the rods and the fluid in the well, is admitted to the pumping cylinder until a point near the end of the upstroke is reached where the intake closes. At the end of the stroke the exhaust valve opens and the pressure decreases to the value required to support the weight of the falling rods and the air is conducted back to the intake of the compressor where it is again boosted to the discharge pressure and the cycle is repeated.

"A control valve maintains the supply-line pressure at the proper value by passing into the return system any excess quantity over that required for operation of the cylinders. This valve is normally closed as the required volume is closely regulated by a combination of clearance and engine speed. Another control valve performs a similar duty in maintaining the return-line pressure by relieving any excess supplied by the make-up cylinder. This valve is also normally closed by regulation of the make-up quantity.

"The pumping of a deep well with sucker-rod pumps involves theoretically the lifting of a weight of a certain magnitude a certain distance and the lowering of a weight of a lesser magnitude the same distance. The two weights are respectively the weight of the rods plus the fluid and the weight of the rods in fluid. These are the two weights supported by the polished rod alternately modified to some extent by acceleration forces and friction in the well when motion occurs.

"These weights determine the two operating pressures used in the pneumatic pumping system."

* * *

"With the two operating pressures established, the volume required of the compressor to circulate the pumping cylinders depends solely on the number and length of polished-rod strokes necessary to produce the wells. This basis of establish-

ing the power requirement is a familiar problem irrespective of the method used for actuating the rod string. Due to the unknown bottom-hole pumping conditions among which might be mentioned submergence, viscosity, gas, and plunger travel, the prediction of the volumetric displacement of the well pump can only be a guess at the best. The intelligence of this guess is governed largely by the degree in which pertinent facts are assembled, knowledge of approximately similar pumping conditions, and experience. With the apparent pump efficiency established the estimate of compressor requirements for a well or group of wells is a comparatively simple computation. . . . The use of identical equipment in each well regardless of fluid capacity is made possible by the extreme flexibility of polished-rod speeds available with the pneumatic pumping cylinder. A range of from 2 to 26 s.p.m., equivalent in capacity from a minimum of eight per cent to a maximum of 100 per cent is available by adjusting the throttle valves at the intake and exhaust of the cylinder. Rarely will the well fluid requirements on a given lease have a wider variation than possible with this range of speed."

* * *

"Adjustable cut-off is provided on the upstroke and compression on the downstroke as a further economy on the volume used. The amount of each setting is a function of the piston speed. The values shown are those easily obtained in practice. At the cut-off point the intake valve closes and with no further admission of air to the cylinder the piston completes the stroke by virtue of expansibility of the confined air. At the point of compression the exhaust valve closes and the confined air at exhaust pressure is compressed to intake conditions. . . . Instances of 32-in. cut-off and 20-in. compression at 23 s.p.m. have been noted in field tests. Stroke, cut-off, and compression are adjustable by 4-in. increments to a maximum determined by limitations of cylinder length.

"The quantity of air required to be circulated through the cylinder to meet the requirements at each well is determined by the displacement and upstroke pressure of each pumping cylinder corrected for cut-off and preheating.

"Preheating is accomplished through the medium of any number of types of gas-fired preheaters or by means of exhaust gas from engines where used to drive the compressor. The value of preheating as applied to pneumatic pumping cylinders cannot be overestimated when it is realized that the volume handled through the compressor and the capacity can be cut in half by raising the temperature at the pump head inlet from 60 deg. to 580 deg. fahrenheit. Temperatures up to 800 deg. fahr. have been maintained in the field tests although general practice is to limit these values between 300 and 450 deg. fahrenheit."

* * *

"The sum of the volumes required by each well in the group determines the compressor capacity of the plant. A certain amount is added to the total to take care of losses by leakage. This leakage or make-up quantity at compressor intake pressure is sometimes available from other sources in existing compressor plants but generally must be supplied either by a small single-stage compressor driven by the main compressor or by the type of compressor cylinder recently developed and available for most of the existing gas or Diesel compressors in which the boosting of the circulating medium as well as the supply of make-up for leakage is taken care of in the same cylinder as previously described.

"The highest upstroke pressure and the lowest downstroke pressure required by any well in the group and the total volume required determine the power requirements."

* * *

"The selection of the type of compressor is largely a matter of the availability and cost of power. Natural gas always associated with the production of oil is usually available in sufficient quantities; however, where the gas is either unsuitable or in insufficient quantities for fuel requirements, electric, gasoline, or Diesel drive may be the answer. Modern gas engines which can be converted to Diesels at a small expense are applicable to conditions where future scarcity of gas is a probability."

* * *

"Since there is no problem of balancing well loads involved with this system the compressor plant can be placed at any convenient location on the lease without materially affecting the quantity of piping used to connect the wells. The probability of handling large quantities of water later offers no difficulties and requires no change whatever in equipment. Should the increased fluid in the edge wells be greater than the decrease in those farther up the structure so that the power demand exceeds the original plant rating, additional compressor capacity can be readily added at any time to the existing system. No other change in equipment need be made except possibly the running of larger plungers in wells producing in excess of 500-600 bbl. fluid per day."

* * *

"The pneumatic pumping head eliminates peak loads on the sucker rods by virtue of a controlled pull determined by the operating pressures used. Both upstroke and downstroke loads are uniform and within the pressure range used, resulting in a minimum of stress swing. The polished rod, however, being unconstrained to move in a given path and floating on a compressible cushion reacts freely to load changes originating in the well and occurring throughout the stroke cycle. The load variations are probably due largely to the natural period of vibrations of the elastic rod string modified by the damping effect of the fluid and variable rubbing friction."

BACK-SIDE CRANK DRIVES

Data on the maximum capacity of back-side crank drives are difficult to obtain because of the variable well conditions found in actual field practice. In this connection, Allen,[84] in citing recent experiences in the Seminole field, mentions a pumping well, driven from a back-side crank, that is producing 330 bbl. of fluid from a depth of 4300 ft. with a 2-in. I.D. insert pump in 2½-in. tubing, ¾-in. sucker rods, 49-in. polished-rod stroke, and 700 ft. of 1-in. upset rod line with 34-in. stroke at 18 strokes per minute.

In regard to rod-line losses due to friction it is estimated that they will vary from 0.1 to 1.5 hp. per 1000 ft. of rod line, depending upon the number of hold-ups, hold-downs, and swings in the line, and also upon the size of the line itself.[84]

Attention is drawn to two articles on back-side crank pumping,[85, 86] one of which appears on p. 22 of this issue.

QUESTIONS

1. In what essentials does the system of transmitting power pneumatically to wells from a central plant differ from the conventional types of central pumping powers?
2. What is the purpose of preheating the air or gas in the pneumatic well-pumping system?
3. How is the load balanced in a well produced by the pneumatic system of pumping?
4. What are the maximum depth and load that you know of or have observed on a well pumped by a back-side crank?

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83"Central Power Plants Transmitting Power Pneumatically to Wells," by Paul D. Cornelius—Paper presented before A.S.M.E. Oil and Gas Power Meeting, Tulsa, Oklahoma, May 8-11, 1935.

84"Central Mechanical Power Plants for Well Pumping," by Austin Allen, Jr.—A.S.M.E. Oil and Gas Power Meeting, Tulsa, Oklahoma, May 8-11, 1935.

85"Backside-Crank Pumping in Kansas Fields" (Part 1), by Van D. Bennett—*The Petroleum Engineer*, p. 30, May, 1935.

86"Backside-Crank Pumping in Kansas Fields" (Part 2), by Van D. Bennett—*The Petroleum Engineer*, June, 1935.

Elements of Applied Petroleum Refining

By W. L. NELSON
Consultant*

Article XX

HEATING AND HEAT LOSSES—(Continued)

PIPESTILL HEATERS

THE rapid advances in petroleum technology during the last decade can be attributed to a large extent to the development of pipestills or tubestills, and fractionating towers. The major advantages of the pipestill over the shellstill are:

1. The rate of heat absorption is much greater.
2. The danger of a serious fire is less.
3. The pipestill is best adapted to continuous operation.
4. Flash vaporization can be practiced in the pipestill.

The customary rate of heat absorption for shellstills seldom exceeds 2000 B.t.u. per sq. ft. per hour, whereas in pipestills, rates of 10,000 B.t.u. per sq. ft. per hour are not uncommon. Usually not more than 70 bbl. of oil is present in the tubes of a pipestill and in case of fire, the flames can be limited to the furnace chamber and extinguished with steam. Flash vaporization has not yet been introduced in this series. At this stage it will be sufficient to say that when an oil is heated to the outlet temperature of a pipestill, the vapor that tends to be produced in the tubes cannot separate from the remaining liquid and this vapor aids in causing a larger percentage to distill than could be distilled by heating the oil to the same temperature in a shellstill. Flash vaporization has been of tremendous importance in the development of high temperature distillation processes, such as vacuum distillation for lubricating oil stocks, the rerunning of lubricating oil stocks, and the distillation of tars for the production of asphalt.

The general features of the construction of pipestills can be gained from Article III of this series (January, 1934) and particularly Figs. 8 and 9.

RADIANT AND CONVECTION SECTIONS. The tubes of a pipestill are usually thought of as two distinct heating zones—the radiant section and the convection section. The radiant tubes are situated in the combustion chamber so that the flame delivers heat to them by radiation. The hot gases then pass through the convection section and finally pass to the stack at a relatively low temperature.

The transfer of heat by radiation is governed, to a large extent, by the flame temperature. If the flame temperature is high the radiation is great and vice versa. The two factors that have most influence on the flame temperature are:

1. Amount of excess air. Obviously the more air that is heated in the flame the lower will be the flame temperature.
2. Heating value and flame characteristics of the fuel.

The amount of excess air is defined as the percentage of air used in excess of that required to burn the fuel completely to carbon dioxide and water vapor, etc. The effect of excess air in reducing the flame temperature, or more particularly the intensity of radiation, is indicated in Table 28.

*Professor of Petroleum Refining, University of Tulsa.

The effect of the fuel when using 30 per cent excess air and absorbing 50 per cent of the heat generation in the radiant section is approximately shown in Table 29.

It is interesting to note that when large amounts of heat are absorbed in the radiant section, the rate of absorption per sq. ft. of surface decreases. As an example, if the amount of the heat liberation that is absorbed in the radiant section is increased from 30 to 60 per cent, the amount of surface required is not double but almost twelve times as much. This relation is indicated in Table 30 for the firing of 100 lb. of 9.2 A.P.I. cracked tar with 30 per cent excess air.

The factors that govern the rate of absorption in the convection section are the temperature and velocity of the gas, and to some extent the diameter of the tubes. The relation between these factors is indicated by the transfer rates given in Table 31.

A more complete discussion of the design of pipestills is given in "Modern Pipestill Heater Design," *The Petroleum Engineer*, April, May, and June, 1933.

COMMERCIAL APPLICATION. The foregoing discussion of heat absorption in the radiant and convection sections does not indicate much concerning the rates of absorption that are used in commercial practice. The heating of the oil is a delicate operation because of the tendency for the oil to decompose and deposit coke or become discolored.

The heating involved in the topping of crude oil is a relatively simple operation and radiant rates of absorption of 10,000 B.t.u. per sq. ft. of outside area have been successfully used. This high rate is possible because the oil is not heated to a high temperature for a long length of time and a small amount of discoloration is not greatly harmful; however, when heating such materials as finished lubricating oil, in the rerunning of these materials, or when heating to 870 to 1000 deg. fahr., as in cracking furnaces, much lower rates of absorption are necessary. In these operations, the rate of heat absorption in the radiant section seldom exceeds 5500 B.t.u. per sq. ft. of outside area. Thus, the sensitiveness of the oil must be considered. A high velocity also aids in avoiding decomposition or discoloration but it is not so effective as a low absorption rate. The absorption rates and oil velocities, based on the volume at 60 deg. fahr.,

TABLE 28

Effect of Excess Air on Intensity of Radiation

(Burning an 8 A.P.I. fuel oil with 50 per cent of heat absorbed in radiant section)

Per Cent Excess Air	B.t.u. absorbed per sq. ft. of projected radiant area.	B.t.u. absorbed per sq. ft. of O.D. radiant area.
0	43,000	13,400
25	28,000	8,900
50	19,000	6,040
100	11,000	3,500

Electricity

HAS MANY FRIENDS....

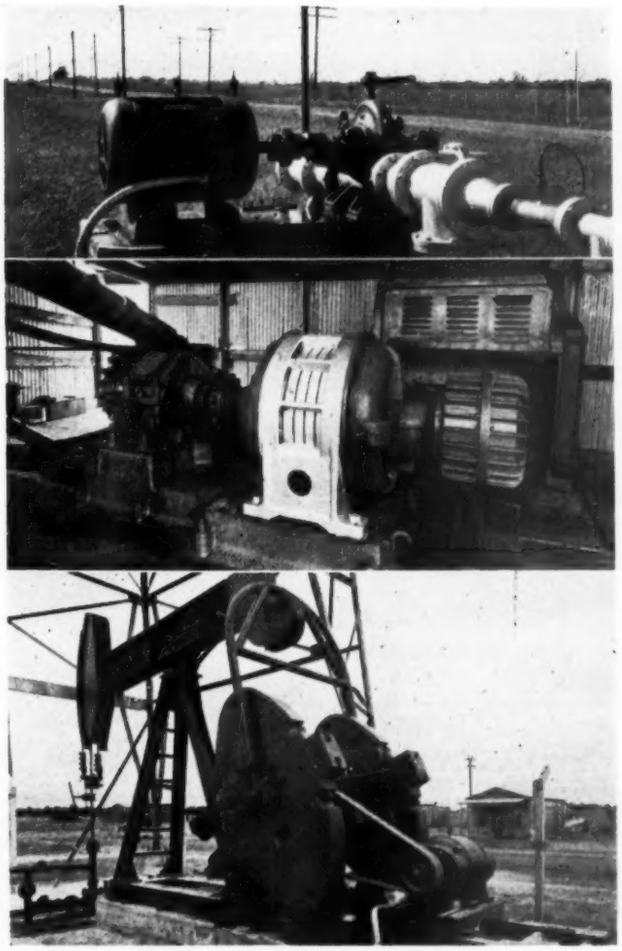

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TABLE 29

Effect of Fuel on Radiant Absorption Rate

Material	Net Heating Value	B.t.u. absorbed per sq. ft. of projected area	B t.u. absorbed per sq. ft. of O.D. area
1. Pure Methane	909*	17100	5400
2. Dry Nat. Gas	1051*	17250	5500
3. Wet Cracked Gas	1893*	19600	6250
4. Wet Nat. Gas	1239*	21500	6850
5. 24.4 A.P.I. Topped Crude	18168†	24500	7800
6. 9.2 A.P.I. Cracked Tar	17324†	27000	8600
7. 7.6 A.P.I. Residuum	17075†	28500	9100
8. Bituminous Coal	13098†	54000	17100

*B.t.u. per cu. ft.
†B.t.u. per lb.

that have been used when heating various stocks are shown in Table 32.

It is beyond the scope of these articles to discuss the subject of heat balances. The computations are not different from those for boilers and such information is available from many sources. It might be noted that pipestills are not usually designed to operate at as high an efficiency as boilers. The temperature of the oil charge-stock is usually so high that it is not economical to have an efficiency higher than 75 per cent. Some modern boilers operate at an efficiency of 88 per cent.

RECIRCULATION OF FLUE GASES. The discussion has thus far been limited to simple stills in which no recirculation of flue gas or preheating of the air is practiced. In stills operating with these modifications, the foregoing discussion of absorption rates, etc., is no longer valid. In recirculation stills, a part of the flue gas is continuously circulated through the furnace.

The obvious effect of flue gas recirculation is to cool the flame and decrease the intensity of radiation from the flame. Even though the flue gas that is recirculated is at 800 or 1000 deg. fahr., it is below the flame temperature, and is an effective cooling agent; thus, flue gas recirculation provides a means of controlling the rate of radiant absorption and at one time it was widely used for this purpose. Now that we have more knowledge concerning the design of the radiant section, flue gas recirculation stills are not used widely. In the simple stills that were discussed heretofore, the rate of radiant absorption could not be altered in a still without changing the fuel, the amount of surface, or by using excess air. The first two of these methods are not always possible and the use of large amounts of excess air is not an economical method of lowering the absorption rate; nevertheless, stills are now designed for a particular service and flue gas recirculation is not used unless the heating operation is one that is so new that no one can judge the rate of absorption that will be possible. The effect of flue gas recirculation on the rate of radiant absorption is indicated in Table 33. The table was computed for the firing of a 15 A.P.I. fuel oil with 25 per cent excess air.

In flue gas recirculation furnaces the heat liberation consists of the net heating value of the fuel plus the heat carried by the flue gas into the furnace box. The recirculation ratio is defined as the lb. of recirculated gas divided by the

TABLE 30

Surface Required for Radiant Absorption

Per Cent of Heat Liberation that is Absorbed by Radiation	Surface Required for 100 lb. fuel— Sq. Ft. Projected Area	B.t.u. absorbed per sq. ft of O. D. Area
30	6	27,500
40	14	15,800
50	32	8,600
60	68	4,850
70	173	2,200

TABLE 31

Convection (and Radiation) Transfer Rates

Velocity Ft. per Sec.	Temperature Deg. F.	Outside Diameter of Tubing 2 in.	4 in.	6 in.
10	800	4 6	5 4	5 9
10	1400	6 1	6 9	7 4
15	800	5 6	6 6	7 4
15	1400	7 0	8 0	8 7

TABLE 32

Commercial Radiant Absorption Rates

Service	Radiant Absorption Rate—B.t.u. per sq. ft. O.D.	Usual Oil Velocity— ft. per sec.	Per Cent of Heat Liberation Absorbed in Radiant Section
1. Topping Crude Oil	9,900	3	48
2. Pressure Distillate—Rerun	8,900	4	50
3. Reduced Crude—Vacuum	8,100	4	51
4. Light Lub. Oil—Rerun	6,400	5	55
5. Cracking—outlet in radiant section	5,400	6	57
6 Heavy Lub. Oil—Rerun	5,400	7	57

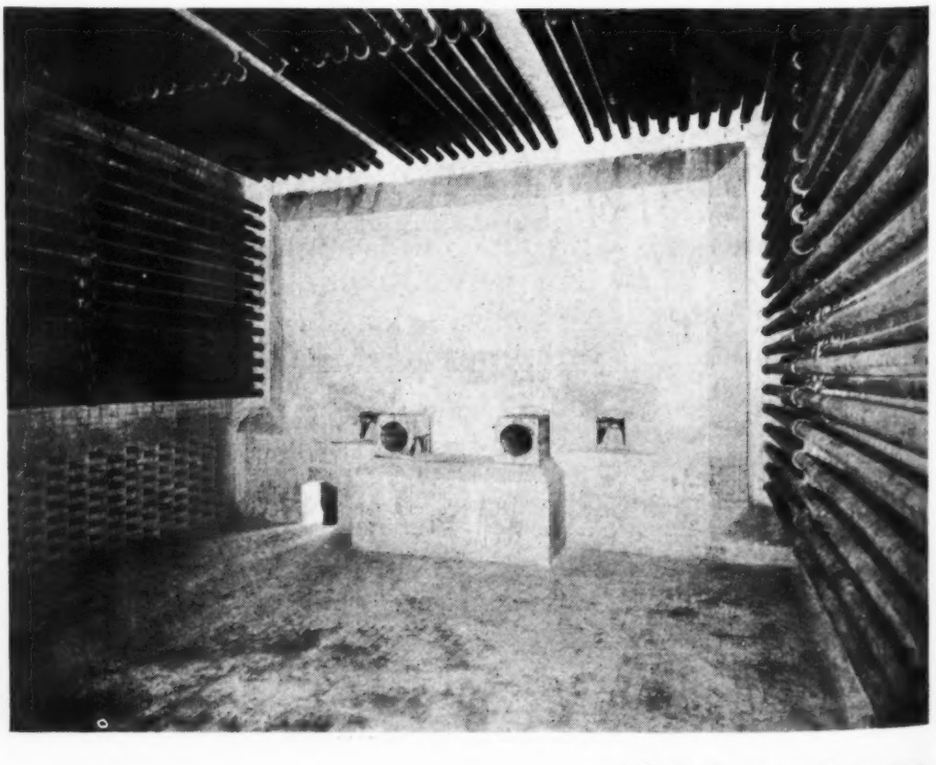


Fig. 40. Interior of a modern pipestill (Courtesy of A. J. Smith Engineering Company).

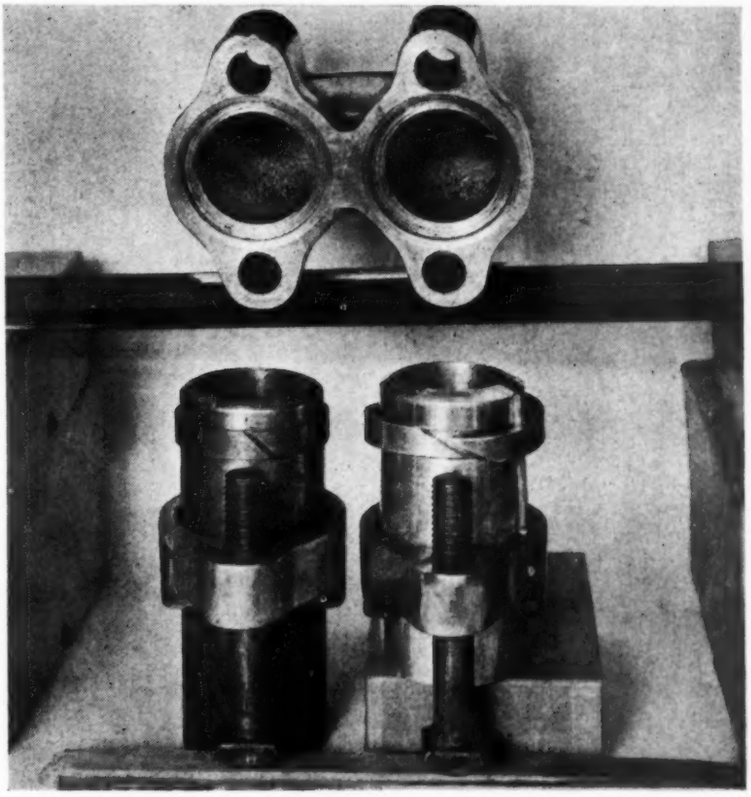


Fig. 41. A common type of return bend (Courtesy of A. J. Smith Engineering Company).

lb. of normal combustion produces or the lb. of stack gas.

Flue gas recirculation is expensive because the hot gas must be circulated by blowers and an air-tight furnace construction is necessary.

AIR PREHEAT. To preheat the air that is used at the burners, tends to raise the flame temperature and thus have just the reverse effect of flue gas recirculation. The advantages of air preheat are: (1), the heat in the flue gas is absorbed by the air, thus giving a higher furnace efficiency; and (2), the burners perform more satisfactorily if the air is under slight pressure, as in an air preheat system. The saving in efficiency is a questionable advantage inasmuch as the same increases in efficiency can be gained at a comparable cost by building a larger convection section and thus cool the stack gases to a low temperature.

The interior of a modern pipestill is shown in Fig. 40 and the details of a common type of return bend are shown in Fig. 41.

TABLE 33

Flue Gas Recirculation and Radiant Absorption Rate

Per Cent of Heat Liberation Absorbed in Radiant Section	Rate of Radiant Absorption, B.t.u. per sq. ft. of projected area, at the following recirculation ratios:			
	0-1	0.5-1	1-1	2-1
20	.....	.....	36,000	19,500
30	.....	36,000	22,500	10,000
40	48,000	22,500	12,500	7,500
50	24,500	12,500	8,000	.....
60	12,800	8,000	.....	.....

QUESTIONS

1. Does excess air increase or decrease the radiant absorption rate?
2. Is a natural gas flame as good as a radiator as a fuel oil flame?
3. Should you use a large or a small amount of surface to obtain a low mild rate of heat absorption in the radiant section?
4. In what ways can the radiant absorption rate be regulated?
5. Why is it usually economical to limit the efficiency of a pipestill to about 75 per cent?

REFERENCES

[1]Nelson—"Modern Pipestill Heater Design," *The Petroleum Engineer*, April, May, and June, 1933.

[2]Wilson, Lobo, and Hottel—"Heat Transmission in Radiant Sections of Tube Stills," *Ind. Eng. Chem.* 24:486, 1932.

[3]Monrad—"Heat Transmission in Convection Sections of Pipestills," *Ind. Eng. Chem.* 24:508, 1932.

[4]Swanson—"The DeFlorez Furnace," *The Refiner and Natural Gasoline Manufacturer*, p. 69, Nov., 1930.

[5]Glenn—"Tubestills—Their Use in Modern Refineries," *The Refiner and Natural Gasoline Manufacturer*, April, 1931.

Data on Natural Gasoline Manufacture Given in Volume

Gasoline plant operators everywhere will find of value the brochure published by the Natural Gasoline Supply Men's Association. The volume, published in connection with that body's fourteenth annual convention recently, contains, in addition to the history, purpose, names of members of the association, etc., important data on natural gasoline manufacture. Technical information found in its pages include the following: "Vapor Pressures of Hydrocarbons (Chart)", "Official Specifications and Testing Methods for Natural Gasoline", "Graphical Analysis of Natural Gasoline", "Oil Conversion Table", "Octane Number vs. Reid Vapor Pressure—Natural Gasoline", "Physical Properties of Lighter Hydrocarbons", "Temperatures of Compression of Natural Gas", "Capacity of Gas Pipe Lines", "Horsepower Required for Pumping Natural Gas", "Theoretical Constants for Calculating Horsepower", "Valve Capacity Chart for Liquids", "Valve Capacity Chart for Gas", "Valve Capacity Chart for Steam", "Method for Calculating Absorber Efficiency and Mineral Seal Oil Rates", "Easy Slide Rule Calculation for Compressor Capacity", "Abridged Volume Correction Table".

8,500,000 Gallons of Gasoline for Air Line

To fuel its fleet of 55 twin-engined transports flying approximately 15,000,000 miles a year on its New York-Chicago-Pacific Coast and other routes, United Air Lines, has just contracted for approximately 8,500,000 gallons of gasoline as a year's requirement, W. A. Patterson, president of United, announces.

Company officials said they believed this is the largest commitment ever made by an air line for a year's supply of fuel. A special high octane gas is required for the 550 hp. supercharged Wasp motors. On a single 2700-mile coast-to-coast flight one of the big transports consumes 1000 gal. of gasoline.

The contract has been placed with the Standard Oil Companies of Indiana and California. Delivery is made at airports in 15 states.

Elements of Applied Petroleum Pipe Line Transportation

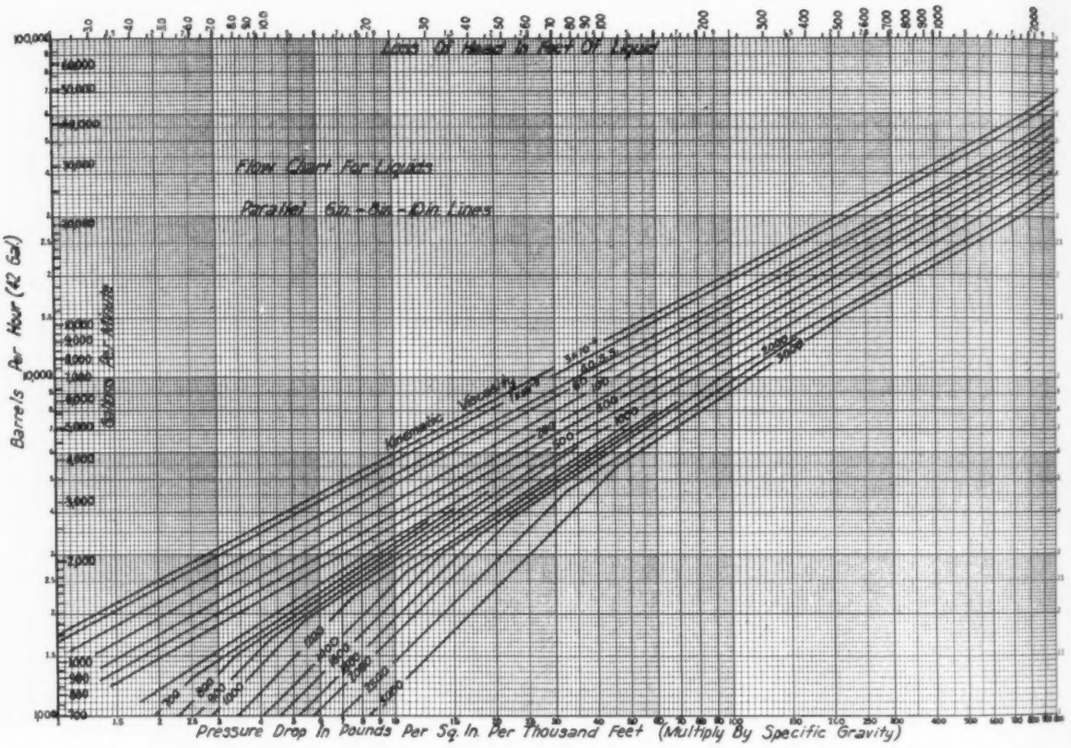
Article II

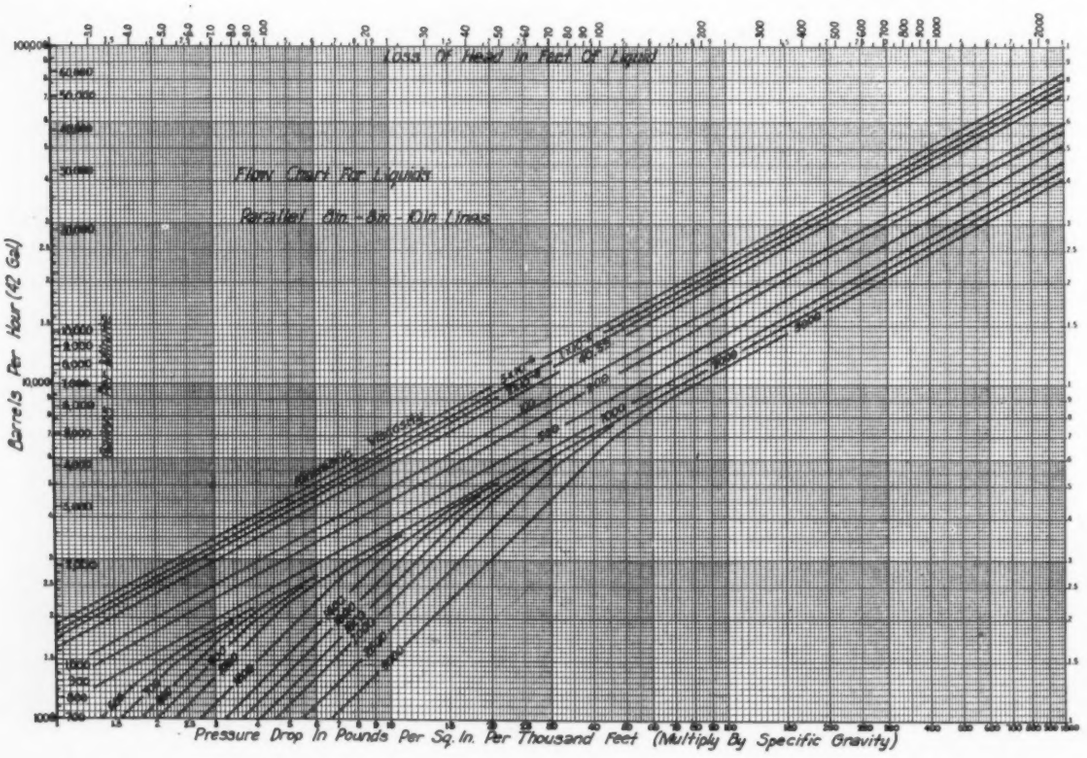
THE FLOW OF OIL IN PIPES AND PIPE LINES

By EMORY KEMLER and L. L. THOMAS

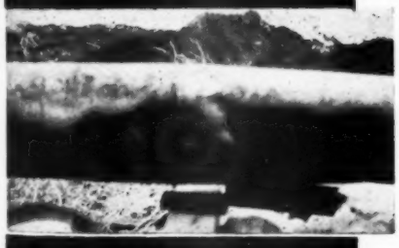
Flow Charts

FOUR charts are given this month for the solution of flow problems in pipes and pipe lines, namely: Parallel 6-in., 8-in., and 10-in. lines, parallel 8-in., 8-in., and 10-in., parallel 10-in. and 16-in. lines, and parallel 14-in. and 16-in. lines.


Loss Of Head In Feet Of Liquid
Flow Chart For Liquids
Parallel 6in.-8in.-10in. Lines
Barrels Per Hour (42 Gal)
Barrels Per Minute
Pressure Drop In Pounds Per Sq. In. Per Thousand Feet (Multiply By Specific Gravity)


Loss Of Head In Feet Of Liquid
Flow Chart For Liquids
Parallel 6in.-8in.-10in. Lines
Barrels Per Hour (42 Gal)
Barrels Per Minute
Pressure Drop In Pounds Per Sq. In. Per Thousand Feet (Multiply By Specific Gravity)

not a failure in the pipe line!



. . . outstanding proof of the stamina of steel gas lines

In the Beaumont district in California a cloudburst struck a canyon not far above a NATIONAL Pipe Gas Line. With overwhelming force, a raging torrent rushed down, bringing enormous quantities of debris and boulders against the line. As an example of the volume of water and its force, a tractor was washed more than a mile down stream from where the accompanying photos were taken. Although the pipe was dented and scarred from the terrific punishment of this washout, not a single failure occurred in the line.

Here is another demonstration of the tremendous strength and stability of NATIONAL Steel Pipe. It shows why this material is being increasingly used for long gas lines traversing rough and uncertain territory. Likewise for city mains, it is coming into use more and more. Vibration (heavy street traffic), cave-ins, trench pressures and such other factors are easily met by the great tensile strength and ductility of NATIONAL Pipe. NATIONAL engineers will be glad to furnish gas companies desired information regarding NATIONAL Pipe in connection with any pipe line project. Correspondence is invited.

ADVANTAGES of NATIONAL STEEL PIPE

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This faster production of good welds is making unequalled low costs for pipe line builders using Multi-Flame Lindewelding.

Multi-Flame Lindewelding is a typical accomplishment of the Linde engineering and research organizations. This method requires less oxygen, less acetylene, and less welding rod than other welding techniques. Welds can be completed in less time. Yet Lindewelding involves no special equipment other than the Multi-Flame Lindewelding Head, the cost of which is only $7.75.

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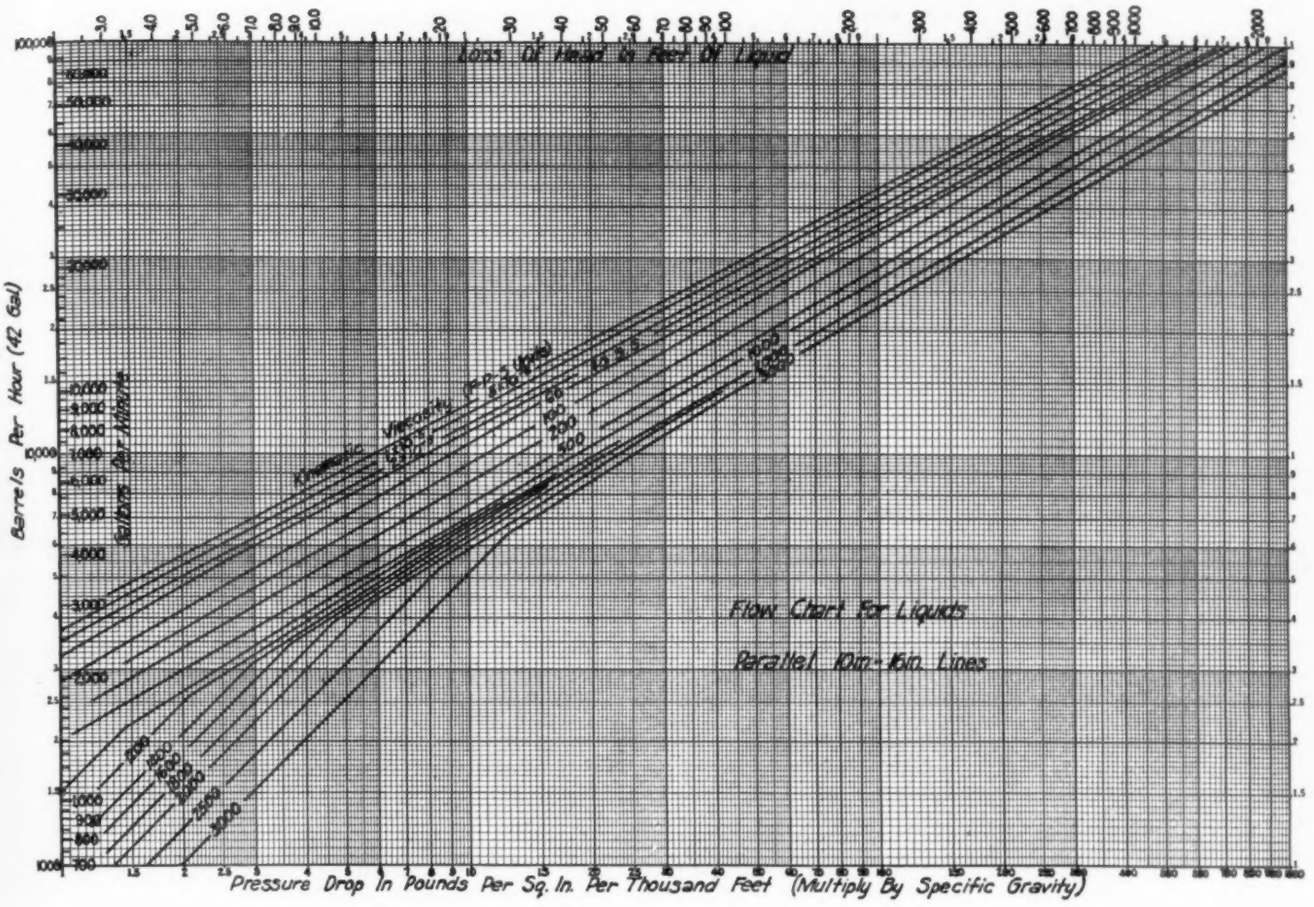
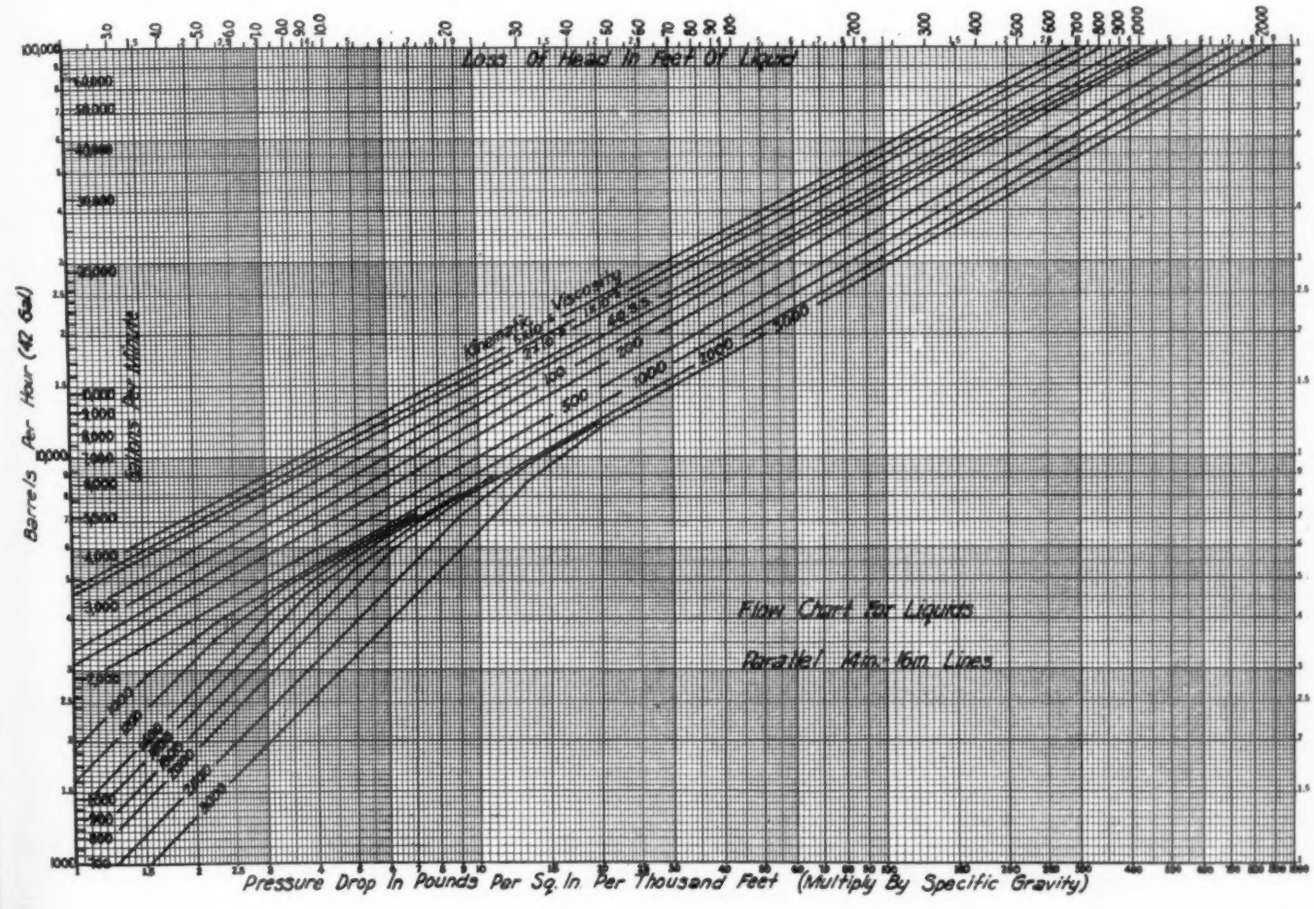
FROM PRODUCTS OF UNITS OF UCC UNION CARBIDE AND CARBON CORPORATION LINDE UNION CARBIDE


Loss Of Head In Feet Of Liquid
Barrels Per Hour (42 Gal)
Gallons Per Minute
Viscosity
Flow Chart For Liquids
Parallel Min.-Max. Lines
Pressure Drop In Pounds Per Sq. In. Per Thousand Feet (Multiply By Specific Gravity)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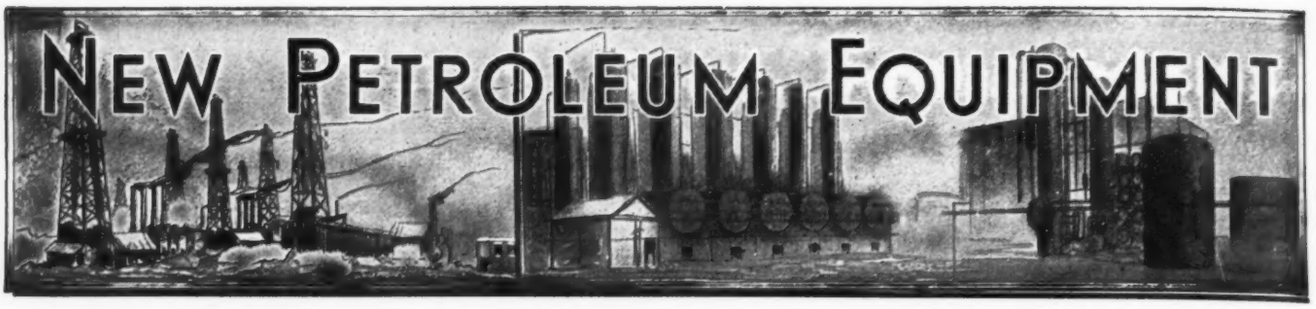


Rock Core Bit

TO provide a positive means of obtaining cores in all hard formations and in formations that are broken or consist of alternating strata, Globe Oil Tools Company of Los Nietos, California, has developed a new roller bearing rock core bit known as the Type KR. With this bit, the greatest economy is provided by replaceable cutter assemblies, while increased percentage of recovery is obtained by the use of two core catchers, the manufacturers state.

The cutter assemblies consist of a full set of two inner and four outer roller-bearing cutters machined from special alloy steel and hardened to obtain toughness and maximum wearing qualities. They are mounted on a core head made from heat-treated steel with strength and hardness that provides for repeated re-runs. No welding of the head is necessary after the heat-treatment and this eliminates the application of excessive heat that often counteracts the beneficial effects of heat-treating. Since the cutter assemblies are replaceable throughout, the same body can be used for run after run, it is pointed out.

The two core catchers consist of (1) a slip-type catcher capable of pulling the hardest core; and (2) a dog or mouse-trap type that provides an effective grip on cores from any formation and is particularly effective in holding broken or soft cores.

In the slip type, the slips are carried on long springs, the upper ends of which are pointed to provide a good grip on the core and thus force the slips down on their tapered seat. The lower ends of the springs carry the slips and are guided by a self-cleaning slot in the skirt ring that prevents twisting the springs from the catcher.

The dog-type catcher is provided with alternating long and short dogs that are actuated by pressure between the outer end of the dogs and a shoulder in the bit head, and by coil springs. The load on the catcher dogs is transmitted directly to the bit head and catcher rings to relieve stress on the pins.

The inner barrel assemblies are made of a special grade of thin-walled tubing and the two ends are welded on. There are no threads on the inner barrel, thus tongs are never required. It has a special bearing and floats freely in the outer barrel to minimize the wear against the core.

All sizes of the Type KR core heads will run on the new Type K outfits, but due to the different sizes of cores taken, a different inner barrel and different bit head sub are required for the adaptation. The Type KR also can be adapted to the old types A, B and C Globe-Smith coring equipment.

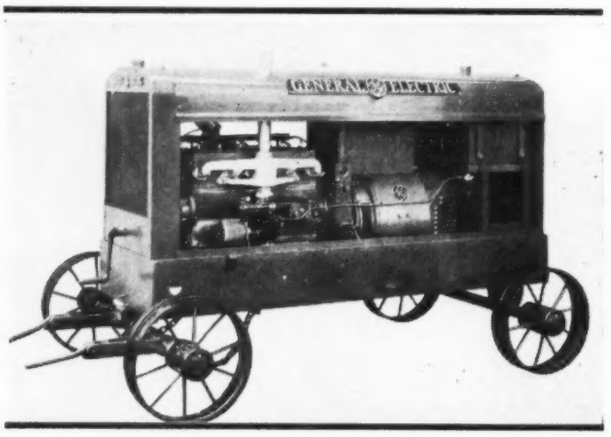
Further details of the new Globe roller-bearing rock core bit will be furnished by the manufacturer upon request.

Improved Arc-Welding Set by General Electric

A LINE of improved, portable, single-operator arc-welding sets that retain the proved characteristics of previous models and incorporate recently developed refinements, is offered by the General Electric Company, Schenectady, New York. Self-stabilization is the outstanding feature of the new arc welders—an advantage that provides excellent performance throughout the entire welding range, using any type of electrodes, bare, lightly fluxed, or heavily coated.

The improved welders belong to what is designated as the WD-30 line. Each welder is a self-contained unit, having no external reactor, resistor, or separate exciter. It is largely due to the self-excited design of these machines that the inclusion of sufficient self-stabilization to provide steady welding characteristics under all conditions is possible. This self-stabilization makes the welding arc both "peppy" and stable at all times, the manufacturers state.

Separate controls are provided for adjustment of welding current and welding voltage. These controls are located on a dead-front panel on top of the machine and at the most convenient height above the floor. On this panel are also located a switch handle for reversing polarity and an instrument with selector switch for indicating welding current and welding voltage. All controls are clearly labeled to facilitate rapid and accurate adjustment.



Portable single-operator arc-welding set; gasoline engine drive, battery starting and ignition; G-E generator, type WD-30 series.

Commutation is excellent at all current values, and operating efficiency is high because of the lack of power-consuming accessories such as external reactors, resistors, and separate exciters, it is stated.

All working parts of the machine are thoroughly protected against damage from water or other foreign materials by completely drip-proof construction.

Position Transmitter and Recorder

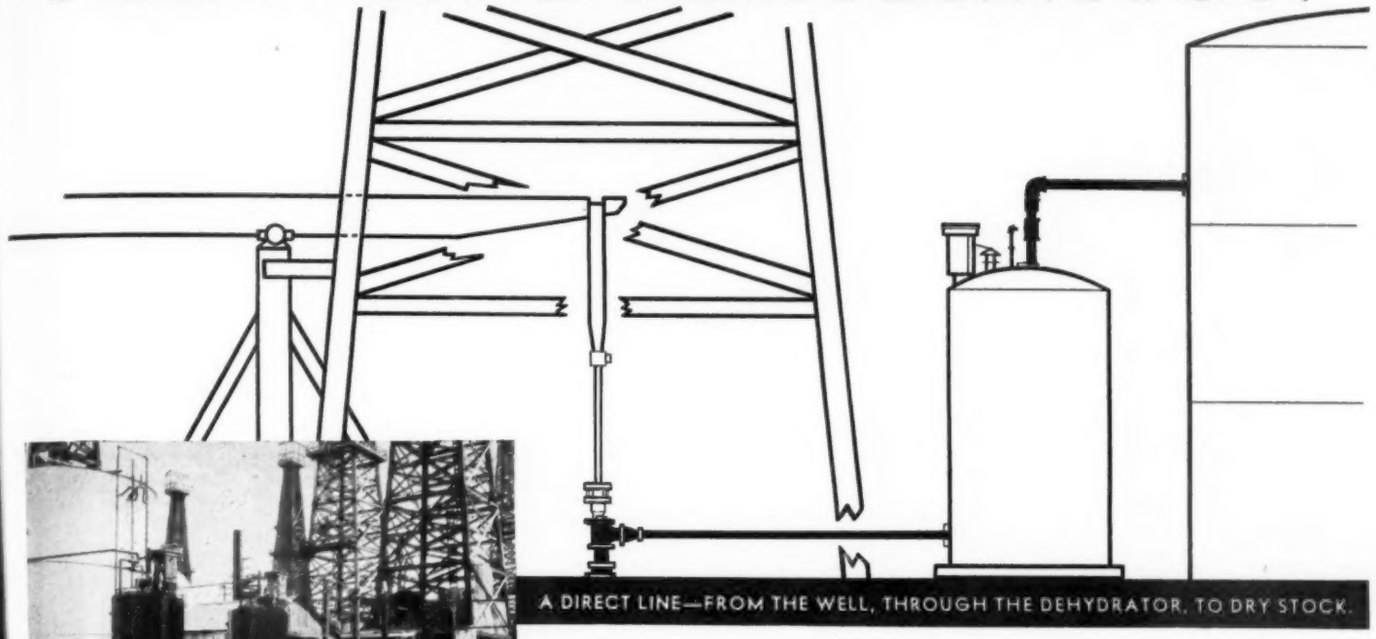
A DUPLICATE position telemeter system for indicating and recording at a distance the position of mechanisms such as bridges, gates, valves or water level in water power plants, engine governor positions, or the position of any important mechanism, is announced by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

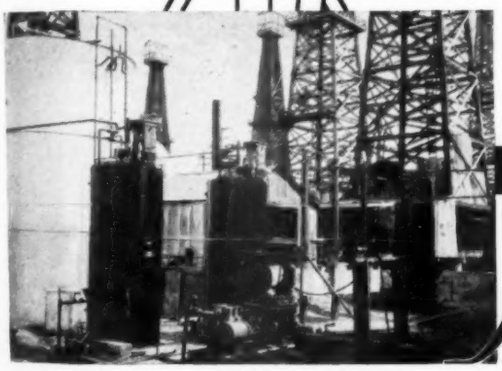
The type "GH" position recorder is assembled in a rectangular case for switchboard panel mounting. An improved duplicate position type of motor operates a direct acting pen that records on a strip-type chart variations in the position of remotely associated mechanisms operating a motor-type transmitter.

PETRECO

The Electrical Process for Dehydrating Crude Oil Emulsions

FLOW-LINE DEHYDRATION





A DIRECT LINE—FROM THE WELL, THROUGH THE DEHYDRATOR, TO DRY STOCK.

A Recent Development Of Importance To Producers

IN flow-line treatment, electrical dehydration of emulsified crudes has been developed to an unusually high state of perfection. This method of treating attains certain desirable results which previously have been impossible by any process or system. It is adapted to wells of practically all production capacities, and to a wide range of average and extremely difficult production characteristics. It offers many important advantages, and affects many direct and indirect economies, all of which accrue directly to the producer. We earnestly recommend that production executives investigate this advanced development in handling crude oil emulsions at once. Petreco engineers will supply complete information and operating data on request without obligation.

A comprehensive article on Flow-Line Treatment appears in the current issue of The Electric Dehydrator. If you have not received a copy, write your nearest Petreco representative, or direct to the general offices, for a copy.

PETROLEUM RECTIFYING COMPANY OF CALIFORNIA

General Offices: 530 West Sixth Street, Los Angeles, California.

Branch Office: Houston, Texas. Branches and Service Men in Principal Oil Fields.

Ingersoll-Rand Pott Impact Wrench

A NEW type of wrench, operating on the principle of "impact," can now be furnished with a reversing mechanism, so that it can be used both for applying and removing nuts, it is announced by the Ingersoll-Rand Company, New York City. The reversing is accomplished by shifting gears instead of reversing the air motor. This method was adopted because a non-reversible multivane motor uses about one-third less air than a reversible motor of comparative size, it is stated. It also prevents accidental reversing, thus adding to the safety of the wrench.

Another feature that has been added is the air-cooling of the accumulator, preventing overheating and resulting in longer life.

This wrench runs nuts on or off at a speed of approximately 600 to 700 r.p.m. and 1200 to 1400 impacts per minute, tightening or loosening.

As torque is applied to the accumulator (rubber) the twisting action shortens the rubber section, thus lifting the hammer from its seat. The energy stored in the accumulator drives the hammer forward so that it delivers a powerful rotary blow to the anvil, on the end of which is attached the chuck. These torsional impacts, occurring at the rate of 1200 to 1400 per minute, exert a powerful turning effect.

This type of turning action makes it possible to remove nuts that could not be taken off except by splitting with a chisel or burning with a torch.

A new 16-page bulletin, form 2152-A, has just been issued. It shows illustrations of the impact being employed at a wide variety of tasks. Copies may be obtained from Ingersoll-Rand Company, 11 Broadway, New York City, or any branch office.

E. C. & M. Type ZO Motor Starter

FOR motors up to 15 hp., 220 volt, and 30 hp., 440-550 volts, The Electric Controller and Manufacturing Company, East Seventy-ninth Street and Woodland Avenue, Cleveland, Ohio, announces the

E. C. & M. Type ZO, weather-proof and dust-tight, across-the-line, oil-immersed motor starter. These starters are enclosed in a case that has been bonderized and then black enameled. When desired, a self-contained ammeter in a dust-tight case also can be furnished. The starter is arranged for remote control, push button automatic operation.

Fluor Gas Cleaner

A SIMPLE, positive type gas cleaner or scrubber has been announced by the Fluor Corporation of Los Angeles, California. It is claimed by the manufacturers that this cleaner will remove over 99 per cent of the moisture and dirt in the gas stream.

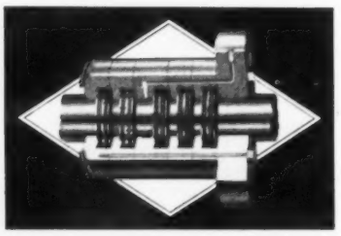
The cleaners are available in two types. Sizes are predetermined by the volume of gas to be handled. Because of their simple, "fool-proof" construction and freedom of moving parts, they may be operated 24 hours a day, day in and day out, it is stated. The makers say the only attention required is the removal of the water or dust that settles in the lower compartment.

The Fluor cleaner has no complicated operating mechanism or movable parts to wear and be replaced, it is pointed out. They can be furnished with different types of interior metal cones and screens, depending upon the characteristics of the gas being cleaned.

One of the features of the Fluor cleaners is the fact that the pressure drop in both the moisture and dust remover is small. There is a minimum amount of resistance to the passage of the gas from the time it enters the cleaner until it leaves.

A circular describing the action of both the moisture remover and the dirt remover has been prepared. Copies will be mailed free to those writing the Fluor Corporation, 909 East 59th Street, Los Angeles, California.

COOK'S METALLIC PACKINGS . .



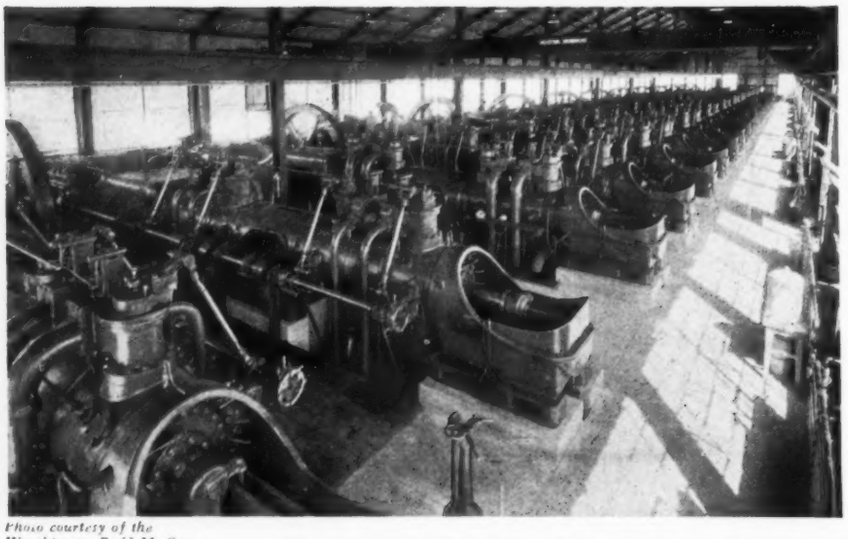


Photo courtesy of the Worthington P. & M. Corp.

. . . PREDOMINATE IN THE NATURAL GAS INDUSTRY

Wherever you may look throughout the oil and gas fields you will find COOK'S Metallic Packings predominate. A noteworthy installation is the 456 sets of COOK'S Power Packing and 114 sets of COOK'S 800-lb. Compressor Packing in the 57 Worthington Gas Engine Compressors serving the Chicago-Amarillo Natural Gas Line.

"Sealing Pressures Since 1888"

WRITE FOR INFORMATIVE LITERATURE

C. LEE COOK MANUFACTURING CO.

INCORPORATED

New York Cleveland Los Angeles Baltimore LOUISVILLE, KY. Chicago Tulsa New Orleans San Francisco

Rector Type "L" Bradenhead

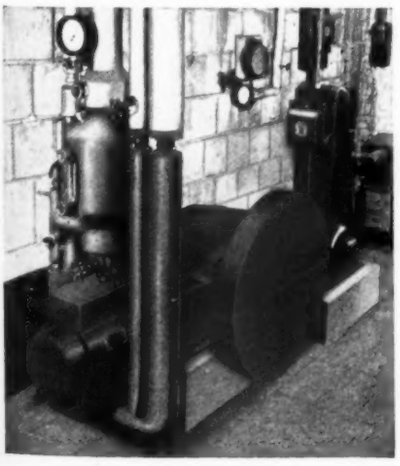
RECTOR Well Equipment Company, Inc., Fort Worth, Texas, announces production on the Rector Type "L" bradenhead, 1500-lb. pressure. The difference in design compared with higher-pressure Rector heads is the absence of the recessed coupling. The split rings, which are extra heavy, sit down on a 45-deg. angle to form a metal to metal shut-off, as in the high-pressure and Type "M" Rector heads. The extra heavy split ring construction prevents weight of the pipe from collapsing the pipe below the thread, the manufacturers state.

The Type "L" head is repackable under pressure the same as are the Rector high-pressure and Type "M" heads.

It is made of high-grade cast steel. The design is full opening, threaded on the inside at bottom, to avoid a reduction in area between pipe strings.

Worthington Steam Booster Compressors

AN item of interest to steam power plant operators, and steam users generally, is the steam booster compressor offered by Worthington Pump and Machinery Corporation, Harrison, New Jersey. Its purpose is to take steam from an existing boiler system, raise its pressure beyond the capacity of the boiler itself and



distribute it to points of demand. This booster has been developed to take care of situations where, as often happens, a supply of steam of higher pressure than can be obtained from the available steam sources is required for some phase of manufacturing process, or to increase pressure in steam that has been carried through long pipe lines, etc. Under these conditions, where the demand for higher pressure steam is within a reasonable capacity, the installation of a Worthington steam-driven or motor-driven steam booster compressor solves the problem, and the machine will supply steam at the necessary pressure at a fraction of the cost of a new boiler with accessories, as would otherwise be necesary, the manufacturers state. Furthermore, due to the reliability of the unit and controls that may be applied, but little attention to the machine is required, and the steam pressure or temperature determined upon can be regulated within very close limits. This is especially applicable to the many chemical or special industrial processes where a definite temperature must be continuously maintained with practically no variation.

This Worthington booster is a high grade machine, the construction of which has been given careful engineering consideration to fit it for its work and to insure a unit capable of complete satisfactory performance for long period runs, the manufacturers say.

Worthington bulletin L-611-B3, describing the machine in detail, will be furnished on request.

Yes WE'RE GETTING **MORE OIL** AND WE'VE WHIPPED THE PUMP TROUBLE!

"THAT new pump seems to be the answer. You remember we were pulling every few days to replace worn out cups and parts, and had tried about every pump on the market. Yesterday was the 44th day that Fluid Packed Pump has been in the hole, and our production is up because it is staying consistently on the job"

NO, the above is not a fairy story . . . just one of many experiences of Fluid Packed Pumps in troublesome wells. The Fluid Packed Anti-Friction Principle enables production men to secure more oil, in a numerous variety of pumping conditions, with fewer pulling jobs—thus keeping costs where they belong.

If you will submit details of *your* pumping problem, we will gladly show you what we are doing so that you may determine where Fluid Packed Pumps will be of benefit to you . . . a service with no obligation whatever.

FLUID PACKED PUMP CO.
BOX 64 • LOS NIETOS, CALIFORNIA • U.S.A.
MID-CONTINENT AND TEXAS DISTRIBUTION
FLUID PACKED PUMP CO.—MID-CONTINENT
2 S. E. 29TH ST., OKLAHOMA CITY, OKLAHOMA
Gulf Coast Headquarters: 409 Velasco St., Houston, Texas
London Office: Coventry House, South Place, London E.C. 2, England

A MODERN PUMP FOR MODERN CONDITIONS
Protected by Patents No. 1545474, 1545475, 1549175, 1621046; others pending.

New TAG Diaphragm Valve

THE importance of the valve as the business end of any control system and the need of matching the valve with the controller in precision and performance, leads the C. J. Tagliabue Mfg. Co., Park and Nostrand Avenues, Brooklyn, New York, continually to improve the valves that bear their trade mark.

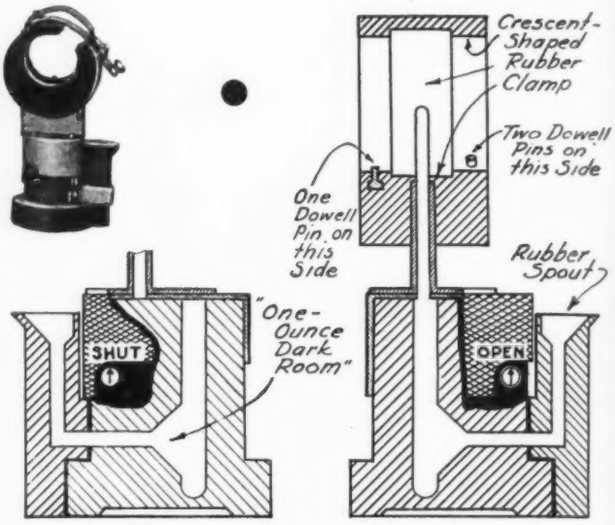
The latest TAG valve development is a new long range throttling top. This construction incorporates several new features of design. Particularly noteworthy is the arrangement for adjusting the spring pressure. The member in contact with the bottom of the spring does not turn when the adjusting feed screw is turned, but, guided by the two vertical fins of the spider arms, merely moves up or down. Thus spring adjustment does not tend to wind up the spring or disturb its normal characteristic in any way.

The company will be glad to send on request a bulletin No. 1117, just published, fully describing the entire line of TAG diaphragm valves and giving complete dimensions as well as instructions for sizing valves.

Developing Tank for Photo-Record Survey Instrument

IN order to develop a survey record disc and make it available for use on the derrick floor as soon as the reading has been taken, Alexander Anderson, Inc., of Fullerton, California, has perfected a "one-ounce" dark room for use with the Anderson Photo-Record Single-Shot Survey Instrument. This device is clamped to the recording unit as soon as it is removed from the outer case after the instrument comes out of the hole and, taking the record disc from the instrument, develops it within four minutes in broad daylight.

This daylight developing tank has a crescent-shaped rubber clamp with metal latch that furnishes a light-tight fit around the recording unit. Into this is moulded a hollow extension of a cylindrical metal cover of a rubber developing tank. The rubber developing tank has a metal stud moulded into one side of it and the tank can rotate 180 deg. in the metal cover. At one end of its movement the word "open" appears on the cover and in the other position the word "shut." The accompanying illustration shows the tank in the two positions.



Attached to one side of the rubber tank is a rubber spout by means of which the fluid used in developing the disc is poured in and out. No light can enter the tank when in the "shut" position, and it is placed in this position when the disc is dropped into it and before it is removed from the instrument. No knowledge of photography is necessary in developing the discs, since powders and fluids are prepared for use on the rig. After development, the disc is dropped out into the hand and is ready for reading.

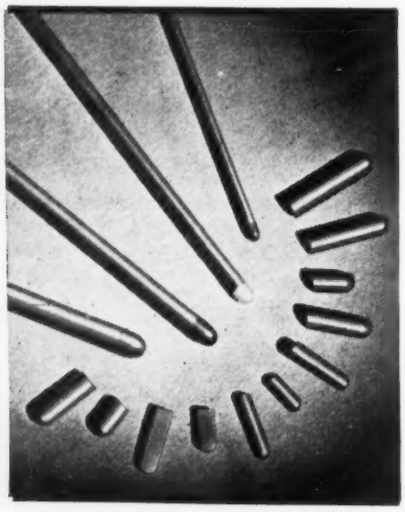
Both the direction and inclination are read direct from the disc without necessity for any computation. The discs are furnished to read to maximums of 5, 10, 25 or 65 deg. of inclination, thus providing maximum accuracy for any condition. Interchangeable inclination units provide for changing the maximum reading to fit conditions and thus make the one instrument applicable for any amount of deviation with the greatest degree of accuracy.

Further details will be furnished by the manufacturer.

Hard-Facing Materials Announced

HAYNES Stellite Company, Kokomo, Indiana, announces the addition of four new sizes of Haystellite Inserts and a series of new rods known as Tube Haystellite to its line of hard-setting and hard-facing materials for oil well drilling tools.

Haystellite Inserts are now available in the 11 standard sizes and shapes, as shown in the accompanying illustration. These inserts are furnished with a special coating so that they will "tin" more easily, thus assuring a better bond with the steel. It will be noted that the 11 sizes consist of six different cross sections. Each has a specific use in producing the most efficient cutting edge for various drilling tools and formations, the manufacturers state.



The addition of the Tube Haystellite to the present series of Haystellite Composite Rods now makes available to oil well drillers a complete selection of rods for every type of hard-facing job. Tube Haystellite consists of hard, irregular shaped particles of "Hard" Haystellite contained in tubes made of Oxweld No. 1 High Test Steel, the Haystellite being screened to provide uniformity in size.

"Hard" Haystellite is distinguished from "Tough" Haystellite, which is used in the manufacture of inserts, by virtue of the fact that it is several points harder on the Rockwell Scale. This additional hardness, and, therefore, increased resistance to abrasion, is obtained at a sacrifice in toughness. This grade would not be desirable in the form of inserts because such large pieces would lack the toughness to prevent chipping and breaking. In the form of Tube Haystellite, however, the "Hard" grade grains are so small, and are held in place so firmly by the high test steel binder, that breakage is minimized.

Tube Haystellite is available in 14-in. lengths, in 3/8-, 5/16-, 1/4- and 7/16-in. diameters, and in screen sizes ranging from 4 on 8 to 100 on 200. All sizes consist of approximately 60 per cent Haystellite and 40 per cent Oxweld No. 1 High Test Steel, by weight. The four diameters are shown in the accompanying illustration.

New Deal Cleaning Machines Mounted on 25-ft. Frames

IN this section of the May issue of *The Petroleum Engineer*, in discussing the pipe cleaning machines of the New Deal Specialty Company, Inc., of Okmulgee, Oklahoma, a typographical error was made in the statement that "all machines are mounted on 25-in. frames." Obviously this is an error, the machines being mounted on 25-ft. frames.

When you are looking for the *best* in Casing and Tubing...

REPUBLIC STEEL

You'll find *everything* in

REPUBLIC

ELECTRIC WELD

CASING • TUBING

Full-length couplings with clean, sharp threads

Perfectly round

Uniform wall thickness

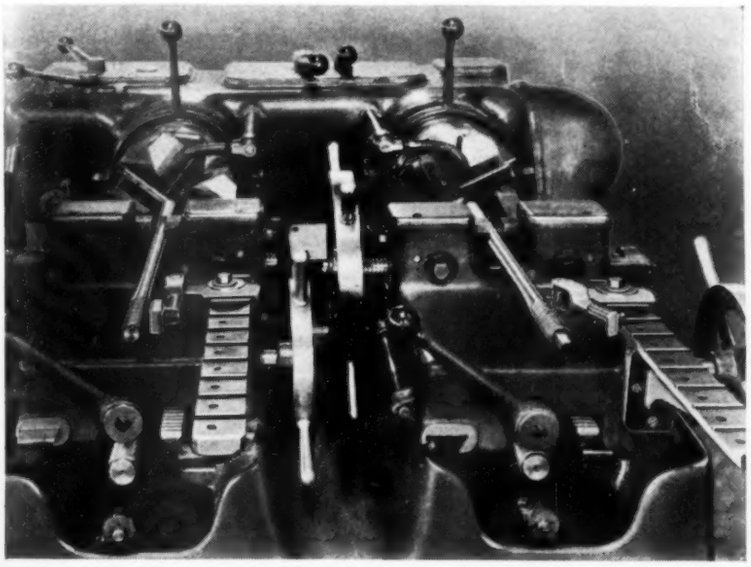
Weld as strong as the wall

Free from scale, inside and out

High yield point, high ductility steel

Timing Attachment for Landmaco Threading Machine

THE Landis Machine Company, Inc., Waynesboro, Pennsylvania, recently placed on the market an attachment for use on its Landmaco Threading Machines for threading reduced body staybolts with a continuous pitch thread on both ends. This attachment is shown in the accompanying illustration.



The timing attachment consists of a bracket attached to the carriage end cover. This bracket is provided with positions for holding the gauge bracket as may be required for various lengths of staybolts. The gauge bracket arm attached to the gauge bracket carries the gauge for timing the thread. All plain radial staybolts are threaded with a 12 pitch thread and the gauge is made to fit. The gauge arm being pivoted in the gauge bracket permits it to be moved readily for clearing or engaging the thread. The attachment illustrated on the right hand side of the machine shows the gauge swung back to permit removal or insertion of the staybolt in the vise, while the one on the left shows the gauge about to be engaged in the thread.

The usual practice is to thread one end of the staybolt in the usual manner on one side of the machine without the use of the timing attachment. The set-up for the other end is made with a master staybolt that has been properly threaded with a continuous pitch thread on both ends. The master staybolt is inserted in the die head staybolts are always threaded with a 12 pitch thread, the leadscrew nut on succeeding threads can be engaged at any point on the screw and provide a proper lead. After the original set-up has been made a thread of continuous lead on both ends of the staybolt is assured, the manufacturers state.

The timing attachment gauge is made in the form of an insert held in the gauge arm. This permits making lateral adjustment of the gauge if desired. It also permits the use of various gauges of different thread forms such as U. S., V, or Whitworth, and of different pitches at a minimum of cost and effort.

Usually only one timing attachment is required on a double-head machine, as its use is not required for threading the first end.

and the chasers closed to properly engage the thread. The timing attachment gauge bracket is attached in its proper position for the length of the staybolt and the carriage set so that the timing attachment gauge will properly engage the thread on the back end of the master staybolt. The leadscrew gears are then disconnected and the leadscrew turned by hand until it engages the leadscrew nut, after which the leadscrew gears are again connected.

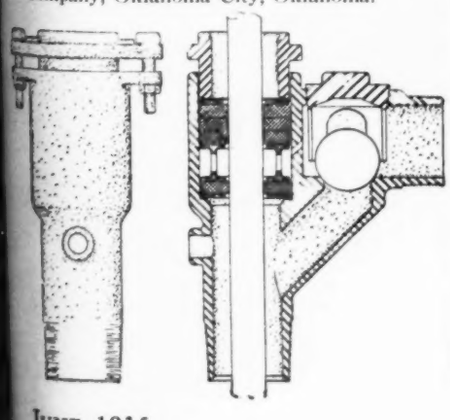
Since a six pitch leadscrew is used on the Landmaco threading machine and the

American Pumping Well Christmas Tree

THE American Pumping Well Christmas tree is a single and non-bulky connection for pumping wells. It cuts down the height from the top of the tubing to the top of the stuffing box, is self-oiling, and has removable ball and seat check valve in body. At least five connections are eliminated, the manufacturers state. Rods may be pulled through the body and packing gland, using packing gland for bell nipple. The equipment is durable and suitable for supporting long strings of rods, it is stated. Standard stuffing box packing rings may be used.

It is made of cast steel to give it long life and to withstand hard usage.

This new equipment was developed and patented, and is manufactured and sold, by the American Iron & Machine Works Company, Oklahoma City, Oklahoma.



Washes the Sand From Behind the Pipe
Increases the Drainage Area
MULTIPLIES PRODUCTION

Part of the sand taken from behind the pipe in one well with The Cavins, increasing the drainage area about 75 per cent.

The CAVINS
3 TOOLS IN ONE

When The Cavins goes off at the bottom of the hole, the tremendous weight of the fluid washes back and forth through the perforations of the screen pipe. These powerful fluid movements wash the sand in from behind the pipe, increasing the drainage area, and multiplying production. Special shoes are supplied for increasing this drainage area to the greatest extent possible. Write for special bulletin 422.

THE CAVINS COMPANY
2853 CHERRY AVENUE, LONG BEACH, CALIFORNIA, U. S. A.
Cable Address: "Cavins, Long Beach" R. J. Eiche, Foreign Representative
Branches at Taft, Bakersfield, Goleta and Santa Paula, California
Cavins Clean-Out Service: Oklahoma City, Okla., and McPherson, Kansas
Cavins Bailer Service: Houston and Kilgore, Texas, and Shreveport, La.

LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

Audrey was up town with her schoolteacher aunt who had just drawn her salary. A thief tried unsuccessfully to snatch the aunt's purse. A policeman who noted a crowd gathering, asked as he arrived at the scene:

"What's the trouble here?"

Said Audrey: "A bad man tried to steal my aunt's pay!"

"Cut out the pig latin," said the cop gruffly, "and tell me what happened."

* * *

Rastus: Mah girl's divine.

Ephraim: Youah gal may be de vine, but mah gal's de berries.

* * *

Dog Catcher: Do your dogs have licenses?

Small boy: Yes, sir; they're just covered with them.

* * *

Father: Son, who is this wild young woman you are running around with?

Son: Aw, Dad, she ain't wild. Anybody can pet her.

* * *

She: Wanta neck?

He: No.

(Pause)

He: Did you say you wanted to neck?

She: No.

He: Well, get out and walk.

She: But I thought you said you didn't want to.

He: I don't; it's the principle of the thing.

* * *

Rufus: That girl over there is good looking, isn't she?

Goofus: Yes. I think I'll ask her if I can't see her home.

Rufus: Oh, never mind. I'll tell her to send you a picture of it.

Right Fast, Now!

A skunk sat on a stump. The skunk thunk the stump stunk and the stump thunk the skunk stunk.

—*Lufkin Line.*

* * *

* * *

Advertisement — YOU GET THE GIRL; WE'LL DO THE REST.

Groom: That's hardly fair.

* * *

If it's funny enough to tell it's been told, if it hasn't been told it's too clean, and if it's dirty enough to be of interest, the editor is likely to get in trouble.

The new shavetail had given the wrong order and had his platoon marching away from him. They were headed straight for an embankment, and the second louie was speechless. At last the regular army sergeant-instructor yelled to the new officer, "Say something, you dumb-bell, if it's only good-bye!"

* * *

An old colored preacher over in Virginia was noted for his use of six-cylinder words, many of which he did not always understand himself. He startled his congregation one morning with this announcement:

"Brethren an's sistern, pay me strick mind, foh I'm erbout to 'nounce. Nex Sunday—dar will be a mos' important celebration in dis congregation. An' I wants all ob you to be on han' to witness de holy doin's, foh I's gwine ter baptize nine adults and sixteen adultresses."—*Bridgeport Bulletin.*

* * *

"What became of the hired hand you got from the city?"

"He used to be a chauffeur and the idiot crawled under a mule to see why it didn't go."

* * *

Motorist: I'm sorry I ran over your hen. Would a dollar make it right?

Farmer: Well, better make it two. I have a rooster that's mighty fond of that hen and the shock might kill him too.

* * *

This is an excerpt from a letter written by a freshman girl up at the Boarding School:

" . . . and I am gaining on this awful food they serve me at the dorm, too! I weigh 120 stripped, but I don't know whether those scales down in front of the drug store are right or not."

* * *

Pat: Me wife don't understand me; does yours?

Mike: I don't know; I don't recall hearing her mention your name.

* * *

Doctor: There's the original prescription. I can't imagine how you made that mistake in putting it up.

Druggist: Humph! I must have mixed your signature in with the other ingredients.—*Judge.*

She reached below her dimpled knee
Into her rolled-down stocking,
And there she found a roll of bills;
Ah, me; 'twas sweetly shocking!

"Why don't you keep it in a bank?"
Inquired a nosey prier,
"The principal is the same," she said,
"But the interest here is higher."

* * *

Service

The genteel motorist had just pulled into the gasoline station for the inevitable gasoline. That being over, the attendant was going through his little ritual.

"Check the oil, sir?"

"Naw, it's O.K."

"Got enough water in the radiator?"

"Yep, filled up."

"Anything else, sir?"

"Yes, would you please stick out your tongue so I can seal this letter?"

—*Pitt Panther.*

* * *

An old Negro had just paid the last installment on a farm when the realtor who sold it to him said: "Well, Uncle Joe, I will make you a deed to the farm now, since it has been paid for."

"Boss," the old darkey replied, "if it am all de same to you I had much rather you would give me a mortgage to de place."

The realtor, somewhat surprised, said: "Uncle Joe, you don't seem to know the difference between a mortgage and a deed."

"Well, maybe not," said Uncle Joe reminiscently, "but I owned a farm once and I had a deed and de Fust National Bank had a mortgage, and de bank got de farm."—*Kablegram.*

* * *

Socialist Father: What do you mean by playing truant? What makes you stay away from school?

Son: Class hatred, father.

—*Annapolis Log.*

* * *

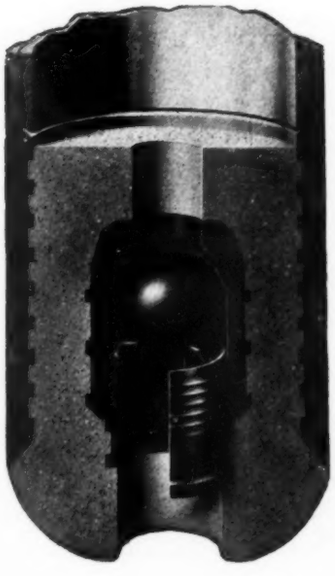
Reginald, once in a mood of choler,
Thrust his head beneath a street steamroller.
The neighbors were strangely surprised to find
How the incident broadened Reggie's mind.

* * *

Angry Wife: Now that I have a frigidaire — see what you can do about a mechanical stenographer.

Oh! I'm so glad! Then we can go to the Party tonight after all?

Yes—we ran and cemented the casing without a hitch and in record time.



Send today for the complete Baker Catalog which describes and illustrates many safe, profit-producing tools — or see the Baker Section in your 1935 Composite Catalog.

THE above is just one of many similar happenings since Baker Pioneered Guiding, Floating and Cementing Equipment with the internal plug and valve assembly made of concrete and bakelite.

More and more operators have come to realize that only Baker Cement Equipment offers STRENGTH—VALVE EFFICIENCY—DRILLABILITY—in a balanced combination which insures fast, safe and economical landing and cementing of casing strings of any length.

There is no metal in Baker Cement Equipment—no dangerous fragments ever are left to interfere with coring directly below the shoe or to deflect the bit and start a crooked hole.

BAKER CEMENT EQUIPMENT

for guiding—floating—cementing casing

BAKER OIL TOOLS, INC.

POST OFFICE BOX 609 · HUNTINGTON PARK · CALIFORNIA

COALINGA • TAFT • HOUSTON • OKLAHOMA CITY • TULSA • NEW YORK

An IMPROVED SUBSTRUCTURE *by Parkersburg*

Corner Columns with an "H" Beam Section

The New TYPE "H" SUBSTRUCTURE is outstanding in simplicity of design and ruggedness of construction.

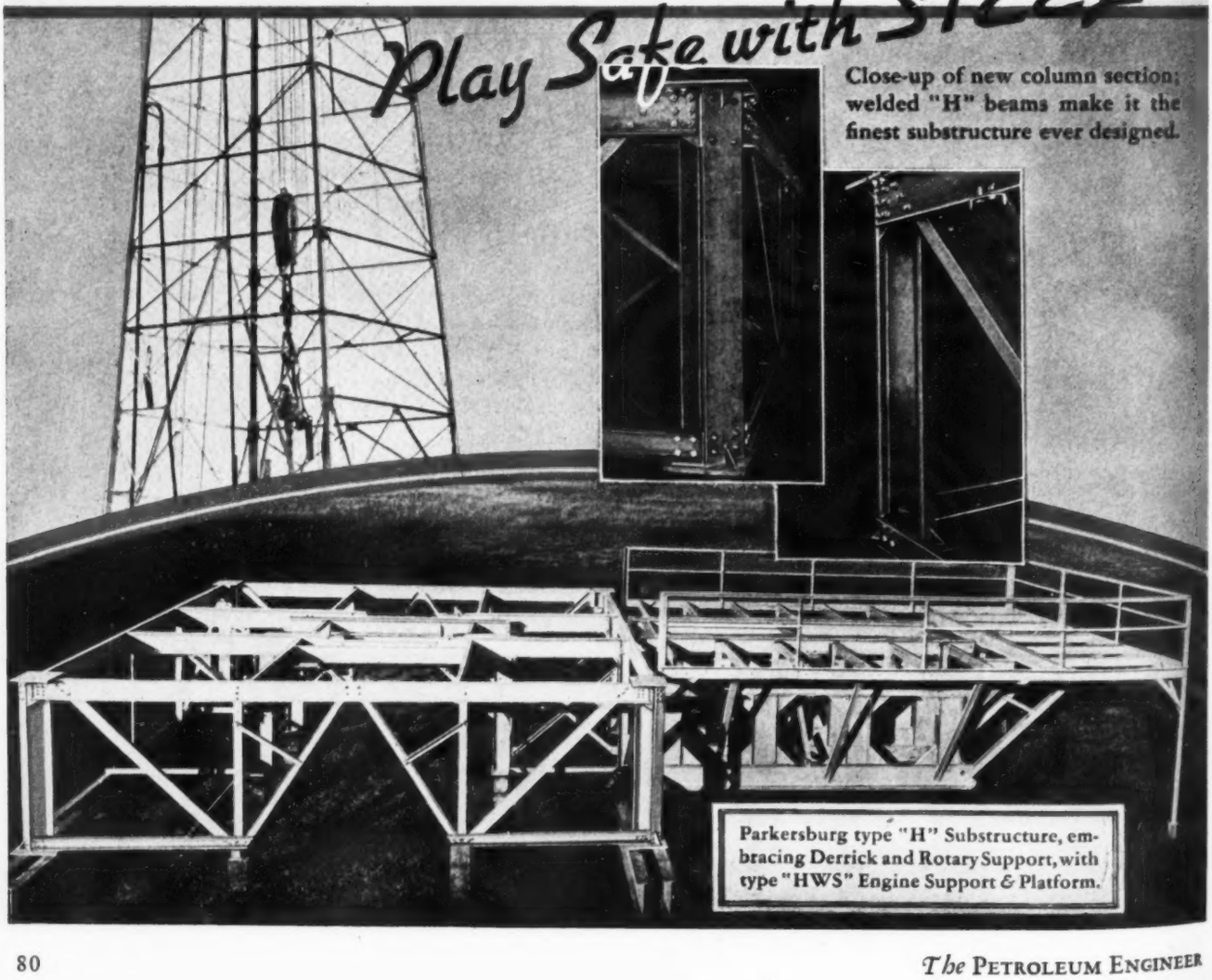
It is the first substructure utilizing a concentrically loaded, wide flange section, applicable to A. P. I. anchor bolt locations. Fewer parts result in easier erection and dismantling and the welded column units reduce the danger of hidden corrosion.

Corner columns are welded and riveted for maximum strength and all sub-assemblies are of a suitable size for convenience in transportation.

The Type "H" Substructure, galvanized or painted, is available, with or without grillage, in three sizes for 24′, 26′ or 30′ base A. P. I. derricks. It can be supplied in capacities ranging from 575,000 lbs. to 1,500,000 lbs.

THE PARKERSBURG RIG AND REEL CO.
PARKERSBURG, WEST VIRGINIA

Play Safe with STEEL



Close-up of new column section; welded "H" beams make it the finest substructure ever designed.

Parkersburg type "H" Substructure, embracing Derrick and Rotary Support, with type "HWS" Engine Support & Platform.

CHARLES L. CLARK has been elected a vice-president of the Drilling and Exploration Company of California and will serve in the capacity of general field manager with headquarters at Avenal, California, in the Kettleman Hills field.

CAL SHUGERT, Gulf Coast district manager for the Guiberson Corporation, spent the month of May in Dallas, Texas, working directly cut of headquarters while recuperating from a slight operation.

HERBERT J. WINN, president of Taylor Instrument Companies, Rochester, New York, sailed recently on the Aquitania for London and a five weeks' business trip abroad. While away he is spending the major part of his time at the plant of Short and Mason, Ltd., manufacturing distributors in Great Britain for the Rochester firm.

TIP DEARMAN, H. J. DEARMAN, and **JAMES L. ANDERSON** have formed the firm of Anderson-Kerr and Dearman, Inc., drilling contractors, and will make their headquarters at Houston, Texas.

BERKLEY WILLIAMS of Richmond, Virginia, has been elected president of the Derby Oil Company of Wichita, Kansas, succeeding A. L. Derby, who resigned and will serve as chairman of the board.

E. L. DAVENPORT, district superintendent for the Shell Petroleum Corporation in the East Texas field, with headquarters at Kilgore, resigned June 1.

ARNETT NORCOTT, of the International Petroleum Company, Negritos, Peru, is on a three months' vacation. He was a visitor in the Mid-Continent in attendance at the A.P.I. meeting at Tulsa.

W. E. HAWKINSON, assistant manager, tractor division, Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, was a recent visitor in Tulsa in attendance at the A.P.I. meeting.

W. H. PATTERSON of the Bishop Oil Company has moved his headquarters from Tulsa, Okla., to Wichita, Kans.

J. K. KERR, senior vice-president and a director of the Ohio Oil Company, Findlay, Ohio, has been retired following 40 years of service with that organization.

W. F. DENBOW has been placed in charge of the newly-opened office of the Ohio-Mex Oil Company, subsidiary of the Ohio Oil Company, at McAllen, Texas. Denbow was transferred from North Louisiana.

HARRY C. POTTS, vice-president, and **W. G. SWANEY,** general manager, of the Kerotest Manufacturing Company, Pittsburgh, Pennsylvania, were recent visitors to the Mid-Continent.

BART MYERS, general manager of drilling and production for the International Petroleum Company, with headquarters at Toronto, Canada, was in attendance at A.P.I. meeting, Tulsa.

J. M. SITLER, purchasing agent at Houston, Texas, for the Humble Oil and Refining Company, has been made first assistant to the general purchaser of the Standard Oil Company of New Jersey, with headquarters at New York City. J. A. Rowe assumes Sitler's post with the Humble.

T. E. KEEFER, field superintendent for the Stanolind Oil and Gas Company in the Elk Basin field, northern Wyoming, has been transferred to Hobbs, New Mexico, where he assumes duties as field superintendent in that district. He succeeds J. P. Gibbons, resigned.

K. M. FAGIN has joined the engineering staff of the Magnolia Petroleum Company, and will have his headquarters at Dallas, Texas.

HENRY COOLIDGE has resigned as superintendent of operations for the Atlantic and Pacific Petroleum Company's properties in Wyoming, and has moved to Oilmont, Montana, where he is associated with his uncle, E. B. Coolidge, in drilling contracting and management of oil and gas properties.

ERNEST SIDWELL, formerly in charge of the Sinclair-Wyoming Oil Company's operations in the Salt Creek field of Wyoming, has accepted a position as general superintendent for the Norbla Oil Company, whose headquarters are at Tulsa, Oklahoma.

NEILS MATHIESON, field manager in Venezuela for British Controlled Oilfields, Ltd., is in London on his vacation. He expects to return to Venezuela the latter part of July.

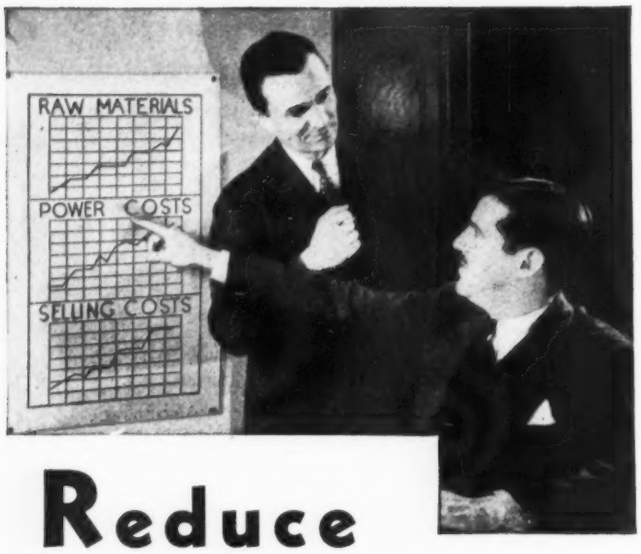
A. C. TEMEL has been transferred from Tulsa, Oklahoma, to Fort Worth Texas, by the National Tube Company, to succeed E. L. Wycoff, who is now at the Bakersfield, California, office of the firm.

LEO MOORE has resigned as drilling superintendent for the Waggoner Refining Company, Electra, Texas, and will operate independently.

S. M. WECKSTEIN, assistant chief engineer, The Timken Roller Bearing Company, Canton, Ohio, was recently in the Mid-Continent in attendance at the A.P.I. meeting in Tulsa.

CLIFTON R. "CLIFF" SWARTS of Lago Petroleum Corporation, is home on leave from Venezuela, South America, where he has been for the last three years. He expects to return to Maracaibo early in August. He has been visiting in the Mid-Continent and the Gulf Coast, and is at present in California.

WALTER C. SHUTTS, Standard Oil Development Company, New York, was a recent visitor in the Mid-Continent in attendance at the A.P.I. meeting at Tulsa. Shutts, before his transfer about nine months ago, was assistant chief petroleum engineer of The Humble Oil and Refining Company at Houston, Texas.



Reduce Power Costs through Correct Lubrication

EVERYWHERE plant managers are recognizing that their power service inevitably shows up in the balance sheet as profit or loss, whether they buy their power or generate it in their own plants.

Gargoyle Lubricating Oils are helping hundreds of plants throughout the Southwest to show power profit through lower power consumption, through reduced maintenance costs, through uninterrupted production and less lubrication expense.

If you would like to have help with your lubrication problem, let a Magnolia Lubrication Specialist tell you about a type of cooperation that has helped many another plant show a lubrication profit.

MAGNOLIA PETROLEUM COMPANY

A Socony-Vacuum Company

General Offices . . Dallas, Texas

Wholesale Agencies and Stocks Throughout Texas, Oklahoma, Arkansas, Louisiana, New Mexico and Tennessee

Get the Extra Safety of GARGOYLE **Lubricating Oils**

Jack Lyall Mid-Continent Representative for McCord

Jack Lyall has been appointed field representative in the Mid-Continent area for the McCord Radiator and Manufacturing Company, Detroit, Michigan. He has been with the McCord company over a period of seven years in general sales, lubrication, engineering, and production capacities. He will contact the trade in the capacity of technical sales and service engineer. His headquarters will be at Tulsa, Oklahoma.

JACK LYALL

Schell Harmon Joins Tulsa, Oklahoma, Bank

The board of directors of the National Bank of Tulsa announce the election of Schell Harmon, of Dallas, Texas, as vice-president. Harmon, for several years has been an officer of the Harris Trust and Savings Bank of Chicago, handling their correspondent bank relationships throughout Oklahoma, Kansas, Texas, Arkansas, and Louisiana, and during the past 18 months has represented several large financial institutions in negotiating oil loans in the Mid-Continent area.

SCHELL HARMON

Harmon, a native of Nebraska, is a graduate of Nebraska University, and Harvard special course in senior banking. He gained his first interest in banking and oil while selling office appliances in southern Illinois, and later joined the Chicago bank, where he rapidly rose from an obscure clerk to an assistant vice-president.

"Seven years of intimate personal acquaintance has given me a very high regard for Mr. Harmon's keen understanding of financial affairs, and his intimate knowledge of the problems of the oil man," said E. I. Hanlon, chairman of the board of the National Bank of Tulsa.

E. A. Bradshaw, president of the Tulsa bank, said: "After many years of intimate contact with Mr. Harmon's work, I am very happy to have him with our institution. He brings to Tulsa and our bank a valuable knowledge, and experience in the banking business, especially as it relates to the oil industry. He has a highly specialized training in banking and financial affairs, and his many years with one of the largest financial institutions of the country in handling their affairs in the Mid-Continent fields, has gained for him the respect, confidence and friendship of bankers and oil men, not only in the Southwest, but in the financial centers of the north and east."

Buffalo Office Republic Steel to New Address

On June 1st the Buffalo, New York, district sales office of Republic Steel Corporation was moved from 475 Abbott Road to 1020 Liberty Bank Building, according to an announcement by N. J. Clarke, Republic's vice-president in charge of sales. The telephone number of the new office is WAshington 7021.

Thomas B. Davies continues in charge of the office as district sales manager, assisted by his present staff.

Continental-Emsco to Export B. S. & B. Line

Black Sivalls & Bryson, Inc., have concluded arrangements with Continental-Emsco Company, Inc., 30 Rockefeller Plaza, New York City, to handle their line of separators, flow treaters, safety heads, and other products in the export field. Since such an arrangement gives B. S. & B. direct representation on the ground in Buenos Aires, Venezuela, Trinidad, London, and Roumania, it affords better service to foreign customers of this pioneer firm.

A. G. Haglund on Extensive Foreign Tour

With an itinerary that includes visits to over 25 foreign countries, A. G. Haglund, of the Axelson Manufacturing Company, left Los Angeles recently to be gone until the middle of January, 1936.

Haglund, who is Axelson's vice-president and direct factory foreign representative, will visit practically every oil field of importance in the entire world during his trip, with the exception of South America, Mexico, and Canada. Except for his journey from Los Angeles to New York and from New York to London, he will travel entirely by plane wherever possible. His return trip from the Orient will be via the new Pacific Clipper Service.

This is the third trip of international scope that Haglund has made in the interests of the Axelson organization during the past 18 months. His last tour included all South American oil fields. The first included numerous points in Continental Europe, in company with J. C. Axelson, president of the company.

Gulf Coast OPERATORS!

All of the above tools are of our own patented design. The releasing features are simple and dependable. All these tools are constructed of alloy steel, scientifically heat treated and finish machined after heat treating. No expense is spared to make them as strong and durable as modern methods and metals can make them.

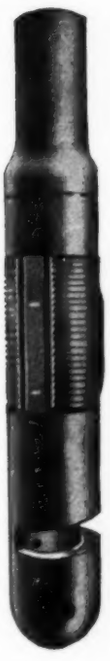
Shaffer Fishing Tools are now being furnished to Texas and Louisiana operators on a rental basis by

STONE OIL TOOL COMPANY
1502 Maury St. Houston, Texas

Shaffer Expanding Releasing Pin Tap

The only tool of its kind to catch tool joints or couplings. Run on left-hand pipe it is screwed into tool joint box or coupling. By lifting up and turning to the left the slips tighten in the coupling or tool joint box so that all the force which the left-hand pipe is capable of may be used to unscrew the fish. If unable to unscrew fish Pin Tap is easily released and withdrawn.

Shaffer-Hamon Rotary Releasing Socket



A modern, strong, dependable releasing tool for recovering drill pipe and tubing, either with or without rotary jars of any type. May be furnished with or without pack-off assembly to force circulation.

Shaffer-Hamon Rotary Releasing Spear

Like the Releasing Socket, this is a strong, dependable tool for recovering casing and liners either with or without rotary jars of any type. It can be furnished with a pack-off assembly which screws into the spear nut and enables circulation to be forced through fish.

SHAFFER TOOL WORKS
Brea, California Houston, Texas
EXPORT — OIL WELL SUPPLY CO.

A New Use for Magnet Wire

One of the large oil companies in Texas has discovered a unique use for magnet wire. The geophysical department handles very high explosives in its field work, and it is imperative that each individual keep in constant communication with his base. Several men report to the same base, and the cost of stringing regular overhead telephone wire would, of course, be prohibitive.

Each man as he starts out from the base simply straps a 5-lb. spool of No. 24 General Electric single cotton enameled bonded magnet wire on his back so that it unwinds as he walks along. When he reaches his destination he cuts the wire, fastens it to his hand telephone, and is in immediate touch with his base.

The wire must be strong in order to withstand the strain; and it must be perfectly insulated to prevent grounding when dragged through mud and water. When the job is finished, each man disconnects his telephone and leaves the wire. The total cost of the communication system is negligible. The oil company has purchased over 5000 lb., or more than 600 miles, of G-E magnet wire for such application.

Hercules Motors Corporation Moves West Coast Headquarters

The Hercules Motors Corporation, Canton, Ohio, announces the removal of its West Coast representative's office from 613 Russ Building, San Francisco, California, to Room 523 Transamerica Building, 7th and Olive Streets, Los Angeles.

Oliver Kelly, who is the direct factory representative for the Hercules Motors Corporation on the West Coast, is now located at the latter address, from which point he contacts the various manufacturers and dealers in the western part of the United States.

Worthington Elects New Director

The election of Albert C. Bruce, president of the United States Hoffman Machinery Corporation, to the board of directors of the Worthington Pump and Machinery Corporation, has been announced.

Bruce also is a director of the Baltimore National Bank and Central Savings Bank, Baltimore, and likewise a member of the reorganization committee of the Symington and Gould Coupler companies.

Engineer's Invention Improves Fire Hose

A new method of laying fabric in wrapped fire hose to eliminate twist under pressure has been invented and patented by A. D. Maclachlan of the technical staff of The B. F. Goodrich Company, Akron, Ohio.

The new construction feature will be incorporated in White Anchor bias-laid fire hose, widely used for industrial plant protection, particularly oil refineries, and chemical plants.

A. A. Dill on Tour of Inspection

A. A. Dill, export manager of the Axelson Manufacturing Company, with offices in New York City, is spending about three weeks at the Axelson plant in Los Angeles, being on a tour of inspection. He plans to familiarize himself with California conditions and, upon his return, visit the Mid-Continent fields before again taking up his duties in New York.

"A Bear For Wear"

If you want super-service with super-safety, specify Grizzly—and be sure you get Grizzly. There's only one Grizzly Brake Block and there's a big difference. Order by name only.

Holds the load easier at any depth. Feeds off smoother when drilling. Speeds up drilling operations.

E. M. SMITH COMPANY

600-650 SO. CLARENCE ST., LOS ANGELES, CALIFORNIA

Sold in Mid-Continent and Gulf Coast By: CONTINENTAL SUPPLY COMPANY

Distributed By: T. T. WORD SUPPLY CO. INC., HOUSTON, TEXAS - In All Their Stores

Frank Brinegar Made Vice-President of Continental Supply

FRANK I. BRINEGAR

Frank I. Brinegar, who for the last two years has been assistant to the president, has been elected vice-president of the Continental Supply Company, Dallas, Texas, W. J. Morris, president of the company, announced recently.

Brinegar became associated with the Continental 14 years ago as a salesman in Kansas. He moved to Tulsa, Oklahoma, in 1927 as assistant sales manager, and in 1930 was transferred to St. Louis, Missouri, at that time headquarters for Continental. He was made assistant to Mr. Morris shortly before the company moved its headquarters to Dallas, Texas, in October, 1933.

Lufkin Foundry and Machine Company Announces Expansion Program

A $50,000 expansion program has been announced by W. C. Trout, president of the Lufkin Foundry and Machine Company, Lufkin, Texas. A new assembly building will be erected and necessary equipment installed. Construction work already is under way, with the Mosher Steel Company, Houston, Texas, the contractors.

The new assembly building will be an extension of the present plant, and will be a structure 165 ft. by 66 ft., 34 ft. under the eaves, and 50 ft. high. This addition will give Lufkin approximately 11,000 ft. more floor space. The structure will be of steel and concrete. Equipment to be installed will include overhead electric cranes, and other modern apparatus.

With 300 men now on the payroll, and business showing a substantial increase, the foundry's present facilities, particularly in the assembly plant, have been badly crowded, it was pointed out.

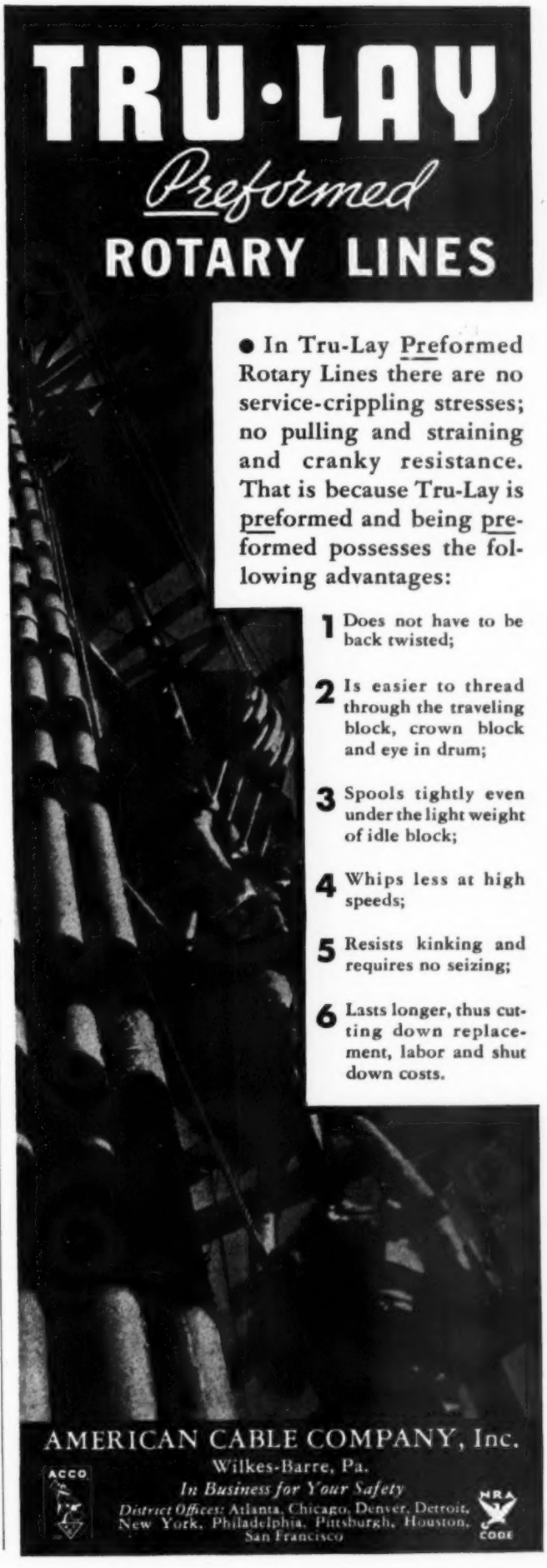
The Lufkin Foundry and Machine Company maintains export offices in New York City, and domestic sales offices in Los Angeles, Tulsa, Dallas, and Houston.

Lee Wright Made Sales Representative For Republic Steel

Lee Wright has been appointed sales representative for the Republic Steel Corporation, with headquarters at 401 Atlas Building, Salt Lake City, Utah, according to an announcement by N. J. Clarke, vice-president in charge of sales for Republic.

Prior to his connection with Republic, Wright had been associated with Zion's Co-operative Mercantile Institution, Salt Lake City, since 1902.

The appointment will enable Republic to serve more efficiently the Salt Lake City territory, which in the past has been handled through Republic's Denver office.


TRU·LAY
Preformed
ROTARY LINES
● In Tru-Lay Preformed Rotary Lines there are no service-crippling stresses; no pulling and straining and cranky resistance. That is because Tru-Lay is preformed and being preformed possesses the following advantages:
1 Does not have to be back twisted;
2 Is easier to thread through the traveling block, crown block and eye in drum;
3 Spools tightly even under the light weight of idle block;
4 Whips less at high speeds;
5 Resists kinking and requires no seizing;
6 Lasts longer, thus cutting down replacement, labor and shut down costs.
AMERICAN CABLE COMPANY, Inc.
Wilkes-Barre, Pa.
In Business for Your Safety
District Offices: Atlanta, Chicago, Denver, Detroit, New York, Philadelphia, Pittsburgh, Houston, San Francisco
ACCO
NRA CODE

Rex Hamaker Director Reed Roller Bit Co.

Rex Hamaker has been elected a director of the Reed Roller Bit Company, Houston, Texas, to fill the vacancy created by the death recently of Underwood Nazro. Hamaker has been with the company since 1928, and for some time has been vice-president in charge of sales.

Directors Natural Gasoline Supply Men's Association Meet

The board of directors of the Natural Gasoline Supply Men's Association met June 3rd at Tulsa, Oklahoma. Following the formal installation of the new officers: J. A. Lupfer, president; G. B. Lane, first vice-president; D. W. McKay, second vice-president; and W. D. Moorer, treasurer, the financial report as determined by the annual audit was read by the secretary and on the motion of M. F. Waters, was unanimously accepted as read.

On motion of W. D. Moorer, the annual dues were set at $50.00 and an initiation fee of $25.00 for new members was agreed upon. This motion also carried the stipulation that resigned members should be required to pay a reinstatement fee. The total of this fee should not exceed $25.00, and is to be assessed at $10.00 for the first year, $10.00 for the second year and $5.00 for the third year since the resignation of the member reinstated.

Axelson Manufacturing Company Opens New Store at Bakersfield, California

In keeping with the increasing volume of California business, the Axelson Manufacturing Company, Los Angeles, announces the opening of a new store. The store is located at 3800 Chester Avenue, Bakersfield, California, and will serve the Kern and West Front fields. It will make possible an even speedier service than has been offered in the past to Axelson customers in the territory.

Ralph H. Kinsloe, Vice-President and General Manager Magnolia, Passes Away

Ralph H. Kinsloe, vice-president and general manager of the Magnolia Petroleum Company, died of heart attack at his home in Dallas, Texas, June 8. Death came unexpectedly while he was working in the yard of his newly-constructed home on Armstrong Parkway.

Kinsloe, who was 50 years of age, had been connected with the Magnolia for 23 years, coming to Dallas from Beaumont seven years ago.

He was born at Fairfield, Iowa, and at the age of nine moved with his parents to Corsicana, Texas. In 1903 he received his degree in mechanical engineering from Texas A. and M. College and the following year entered the service of the Navarro Refining Company at Corsicana.

It was in 1913 that Kinsloe was made assistant manager of the Beaumont refinery of the Magnolia, and in 1928 was transferred to the general offices of the company at Dallas. The following year he was made vice-president and a director. In 1933 he was named vice-president and general manager, the position he held at the time of his death.

He is survived by his widow, Mrs. Willie Edens Kinsloe; and his mother, Mrs. H. E. Kinsloe, of Corsicana.

Funeral services were conducted at Dallas with burial at Corsicana.

THE BOARD OF DIRECTORS
of the
NATIONAL BANK
OF TULSA
Is Pleased to Announce
the Election of

MR. SCHELL HARMON
of Dallas, Texas, as
VICE PRESIDENT
Effective June 11, 1935

Mr. Harmon has been for several years an Officer of the Harris Trust and Savings Bank of Chicago, handling their Southwestern Correspondent Banking Relationships and their Oil Business in the Mid-Continent Field.

E. I. HANLON,
Chairman of Board

A. E. BRADSHAW,
President

"THE OIL BANK OF AMERICA"

Illustrations for Article "Polymer Gasoline from Cracked Gases"

The two figures immediately below refer to the article entitled "Polymer Gasoline from Cracked Gases," which starts on p. 29 of this issue.

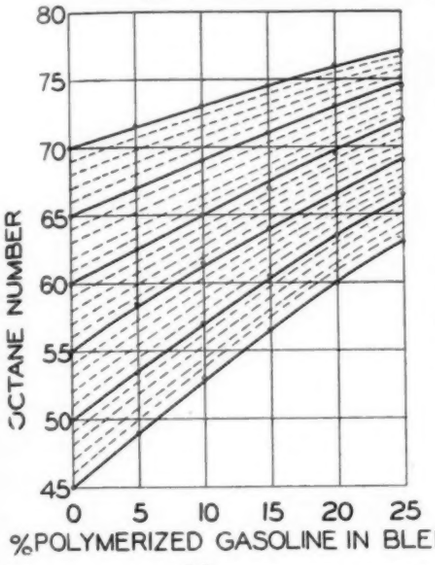


Fig. 1. Blending value of polymerized gasoline when blended with str-run gasolines-blends of ref. fuels C-8 and A-3.

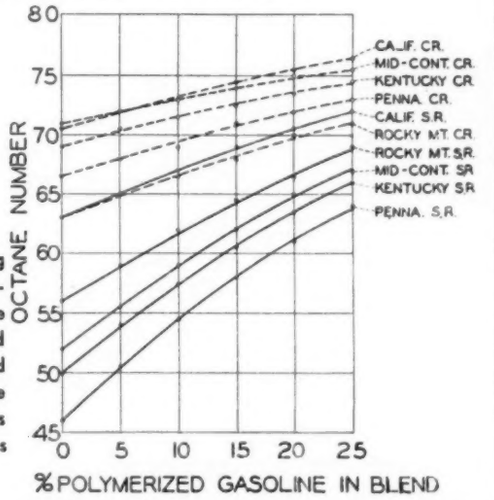


Fig. 2. Blending value of polymerized gasoline when blended with str-run and crkd. gasoline from various crude sources

Book Reviews

Handbook of Butane-Protane Gases. (Second Edition.) Arranged and edited by George H. Finley. Published by Western Gas, 810 South Spring Street, Los Angeles, California. 400 pp., 122 tables, 223 illustrations. Price, $5.00.

This handbook is designed to treat every phase of the liquefied petroleum gas industry—physical characteristics of the gases, manufacture, storage, transportation, and the important fields of utilization.

Virtually all subjects discussed in the volume are of interest to members of the petroleum industry. The first five chapters deal with the nature of the liquefied gases, their analysis, etc. Chapters five and six are devoted to manufacture, from natural gas and from refinery gases, respectively. Chapter eight covers transportation, and chapter nine the design of pressure vessels for these gases. Use of liquefied petroleum gases in internal combustion engines is thoroughly discussed in chapter twelve. The handbook is given permanent reference value by the inclusion of tables of constants, flow diagrams of plant processes, and a wide assortment of technical data.

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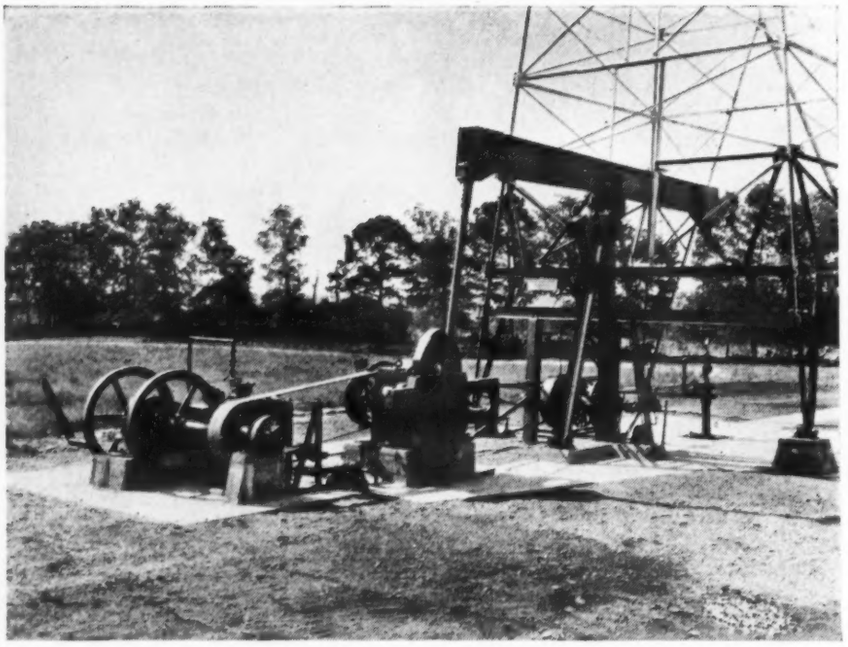

Fig. 1. Installation in East Texas with single reduction herringbone gears with V-belt drive from prime mover to unit

By

L. A. LITTLE*

Geared Pumping Units for Reciprocating Well Pumps[1]

GENERAL. Natural flow, gas-lift, and reciprocating well pumps are the three principal methods by which oil is raised from its subterranean reservoir to the surface of the earth.

In the East Texas field it is possible to use air- or gas-lift successfully for a time; eventually however, the well must be pumped with sucker rods and a working barrel. A majority of the producing companies will begin their artificial lift with sucker rods and never have to go through the expensive process of changing from one method of pumping to another. At this time several wells in the East Texas field are being equipped with geared units after air- or gas-lift has ceased to be effective.

PRIME MOVERS. In order to understand the duty that the mechanical unit has to perform, it is necessary to be familiar with the types of prime movers generally accepted by oil producers. The two main classes of prime movers used in the production of oil are: internal combustion engines and electric motors.

Internal combustion engines are divided into the following classes: Single-cylinder gas engines or twin-cylinder gas engines of slow speed (180 to 300 r.p.m.) type; multi-cylinder gas engines of the high speed (600 to 1200 r.p.m.) automotive type, oil engines, and Diesel engines. There is also a tendency to design multi-cylinder vertical type engines with large rugged parts to operate at moderate speeds of less than 600 r.p.m.

Electric motors as used in the production of oil operate at speeds of from 600 to 1800 r.p.m. with several different characteristics attached to the motor to accommodate pumping, pumping and pulling, or variable horsepower motors to accommodate changing well conditions.

PUMPING CONDITIONS. Most pumping wells are operated between the speeds of 10 to 30 strokes per minute, the average being 20 strokes per minute. There are, however, wells pumping as slow as one stroke per minute, and as fast as 40 strokes per minute.

With the introduction of electric motors, it became necessary to use larger speed reducers between the prime mover and the walking beam than could be obtained with the old standard belted rig. This created a demand for reduction gears, and gave birth to the modern geared pumping unit.

At this point a new factor also entered the field—the power bill. With the actual cost of electricity staring the operator in the face every month, efficient operations spelled direct financial gains. Consequently, the operator turned to geared reduction units, and savings on the power bill were appreciable.

Entwined with these savings is the counterbalanced crank and the flywheel. Without counterbalance it was necessary to do all the work of lifting the rods and fluid with one-half the crank revolution; whereas, the rods returning in the hole set up a regenerative action in the prime mover. The counterbalanced crank distributes the work more uniformly over the upstroke and the downstroke of the cycle. On the upstroke of the rods, the counterweight helps the prime mover lift the fluid and the rods, and on the downstroke of the rods, the rods help the prime mover lift the counterbalance to a position of mechanical advantage.

The counterbalance tends to distribute the load equally between the upstroke and the downstroke of the rods, but this does not give us the absolutely smooth power output

[1]Paper read before East Texas Chapter of A.P.I. at Kilgore, April 30, 1935.

*Engineer, Lufkin Foundry & Machine Company.

condition. In changing from rotary motion of the crank to reciprocating motion of the polished rod, we go from zero velocity to the maximum velocity and back to zero velocity on each half of the stroke. To combat this condition a flywheel is desirable.

The use of the electric power helped to create accurate accounting methods, which brought to the surface the fact that financial savings, through the use of the geared units, were greater due to the fewer repair parts, less labor, and continuity of production, than to the lower power bills. Consequently, geared units have been adapted to slow-speed gas engines with appreciable savings in lifting costs.

TYPES OF GEARS USED IN PUMPING UNITS. There are four classes of gears used in pumping units: Worm, Spur, Helical, and Herringbone.

The worm gear is a desirable type of gearing in that it operates smoothly and quietly, and when the direct-connected motor was the vogue, large reductions and multiplicity of ratios caused them to be popular. The class of worm gear used in pumping units, by actual tests gives an efficiency of from 85 to 89 per cent at the rated loads. Although this is lower than the efficiency accredited to spur and herringbone gears, the worm gear maintains this efficiency throughout its entire life.

The helical gear combines the sliding contact of the worm gear with the rolling contact of the spur gear; however, the helical gear has end thrust that must be absorbed by the bearings, and as the herringbone gear is simply two helical gears with the teeth coming together at an apex, this end thrust is eliminated, and makes the herringbone gear the more desirable application of helical gears.

Herringbone gears have an efficiency of about 96 per cent when new, and as they have combined rolling and sliding friction, do not drop off in efficiency as rapidly as the spur gear does. Most manufacturers design these gears on a wear, rather than on a strength basis, and consequently they have been adopted as one of the popular types of construction for pumping units.

Oil producers demand simplicity of design and operation in production machinery. This necessitates the use of as few rugged parts as possible.

With this in mind a majority of the geared units of recent design in operation today, are single reduction herringbone gears with V-belt drives from a sheave on the prime mover to the sheave on the pinion shaft of the unit (see Fig. 1). The V-belts place a cushion in the mechanism, thus absorbing shocks and furnishing desired speed flexibility. Speeds may be changed at nominal costs by changing sheaves. The use of a single reduction gear as second reduction with V-belt drive as a first reduction, makes it desirable to use a motor within the speed rating of from 600 to 900 r.p.m.

The average single reduction geared unit employs a gear ratio of about 10 to 1. With this ratio of gears, when slower speed prime movers such as the single-cylinder gas engine are used, a V-belt ratio of approximately 1 to 1 is employed. This makes a desirable combination that cannot be used when double reduction geared units are placed in this class of service.

The average double reduction geared unit has a ratio of 30 to 1, which necessitates increasing the speed between the engine clutch shaft and the unit pinion shaft by about three times and then stepping it back down in the unit.

The variables of oil-well pumping are the difficult part of selecting the proper type of prime mover and pumping unit. If the operator knows the maximum amount of fluid he will ever have to lift from the well, and the fluid level from which this fluid must be lifted, it is an easy matter to specify pumping equipment that will give long uninterrupted service. It is well to remember that the oil industry has wasted more money trying to get by with light equipment than ever has been spent on equipment with greater capacity than was needed, therefore, always use pumping units with ample capacity to handle your maximum demands.

One thing is certain: the polished rod stroke must be regulated so as to produce the oil under the most economical conditions possible. This may require slow-speed pumping or intermittent pumping. The category of slow-speed pumping speeds is 14 s.p.m. and less.

Slow-speed pumping may be desirable during proration. But what does slow-speed pumping accomplish? For a 5-hp. load at 5 r.p.m. the same geared unit and counterbalance is required as for a 20-hp. load at 20 r.p.m. The only variation is the size of the motor and the reduction from the prime mover to the polished rod. Slow speed necessitates the use of an extra pair of gears, and an extra set of bearings. As the ratio of reduction increases, the efficiency of the reduction decreases slowly. For the difference in cost of the 5-hp. motor and a 20-hp. motor, a set of gears are eliminated, and the well is pumped six hours per day instead of 24 hours per day. In most cases the electrical demand is metered by 15-minute demand meter and four wells pumping alternately six hours each at 20 strokes per minute with a 20-hp. motor have the same demand as four wells pumping 24 hours per day each at 5 s.p.m. with a 5-hp. motor.

This intermittent method of pumping is more desirable than slow speed pumping as it is more flexible. If the production is to be increased or decreased, the period that the well pumps is re-arranged accordingly, with no changes of motor sheave, motor, or loss of production.

There are cases, however, where due to the demand basis on which the power contract is arranged, or due to the

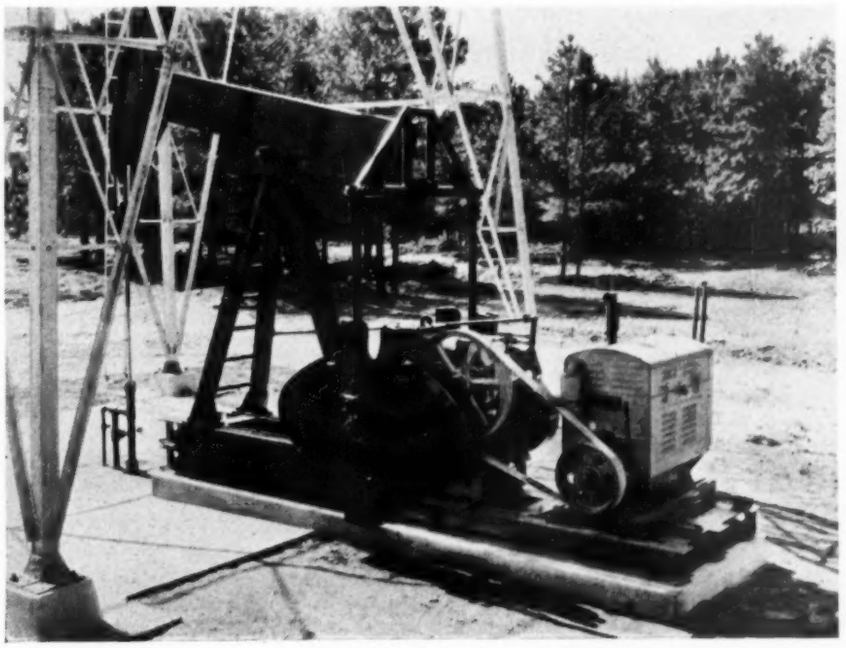

Fig. 2. Double reduction gear with V-belt drive on well in East Texas

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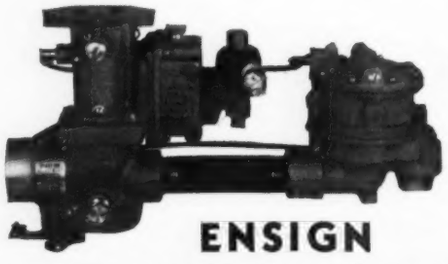

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necessity to maintain even withdrawal it is necessary to go to double reduction gears.

Where well service and cleanout work is to be performed by auxiliary portable equipment, the floor or self contained type of pumping unit is gaining in popularity. This type of geared unit is usually equipped with twin cranks mounted on a structural frame, which also supports the samson post, the entire compact unit setting on a slab in the derrick floor (see Fig. 2). One of the primary advantages of this type of pumping equipment is the facility, economy, and simplicity of installation.

In the East Texas oil field, with proration and the uncertainty of water encroachment, many operators desire to equip their wells with pumping equipment sufficiently large to meet any contingency. Installing large units to pump 40 bbl. of oil per day is out of proportion, consequently, many large pumping units are being equipped with a back crank, to which the pull rod connections may be attached and additional wells pumped by jacks.

Another advantage of one large pumping unit being utilized to pump two or three wells is: that if every allowable is based on potential testing—it will be possible with one large unit to make good potential tests by using its longest strokes and speeding up the unit. This arrangement will be especially advantageous if key wells are used for arriving at the potential.

This is a very flexible arrangement, for during the light pumping period the unit investment may be spread over several wells, and when the heavy pumping period arrives, the less expensive jack installation is replaced by large pumping units.

PULLING EQUIPMENT. Portable equipment is very popular at the present time, but individual well-pumping equipment is more desirable in some instances. Individual pulling equipment, used in conjunction with pumping units, are chain-driven hoists with loose drums, which permit the power to flow in one direction continuously, eliminating reversing and stopping of the prime mover. All the starting and stopping operations are performed by a friction clutch and brake, both of which are a part of the hoisting mechanism.

CENTRAL PUMPING POWERS. The central pumping power is another method of lifting oil. The power has gone through the same process of development as individual units. The speed reduction of the modern power is obtained with totally enclosed gears operating in a bath of oil. They use the same class of prime movers as do individual pumping units. The largest powers on the market today have a capacity of about 150-hp. at 20 s.p.m.

The use of central pumping powers is limited by well-spacing and by surface equipment, which will not permit the pumping of large volumes of fluid. Surface equipment, such as pull rod carriers, hold-downs, hold-ups, swings and jacks are still somewhat crude, but are going through a process of improvement at the present time.

The use of central powers is on the wane in East Texas due partly to the small difference in first cost over a back-crank installation, also it is necessary to make a large investment when the first well on the lease goes dead; furthermore, the investment must be maintained as long as one well produces on the lease.

CONCLUSION. Since the discovery of oil, a reciprocating plunger working in a barrel actuated by a mechanical speed reducer and transmission, has been a principal method by which the bulk of the world's oil has been raised to the surface, although new devices and methods are being tried continually, the old basic design promises to continue, with certain mechanical improvements and perfection.

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M. A. Rutis, oil producer and drilling contractor in the North Texas territory since 1919, has been appointed the joint Oklahoma-Kansas representative for Cameron Iron Works of Houston, Texas, and Rector Well Equipment Company, Inc., Ft. Worth, Texas. He recently opened headquarters at 310 Thompson Bldg., Tulsa, Oklahoma. His appointment brings a wide experience in well control to the upper Mid-Continent for his two manufacturing connections.

C. V. Sidwell General Field Superintendent for British American

C. V. SIDWELL

Carroll V. Sidwell, production engineer in Oklahoma for the Amerada Petroleum Corporation, has resigned to become general field superintendent for the British American Oil Producing Company, of Tulsa, Oklahoma. He succeeds William J. Collier, who has been placed on the retired list of the company. The announcement of Sidwell's appointment was made by William K. Whiteford, executive vice-president of the British American. Sidwell, who has been residing at Seminole, will move to Tulsa.

A. A. Buschow on Trip in California

A. A. Buschow, president of the Bridgeport Machine Company, Wichita, Kansas, and A. A. Buschow, Jr., also connected with Bridgeport, are on a tour of the California oil fields.

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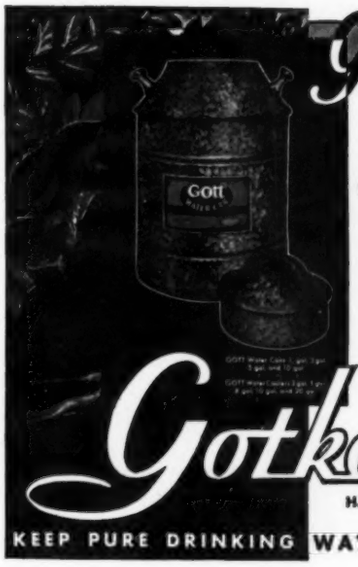

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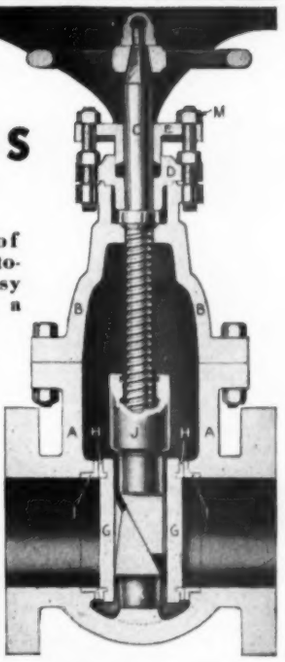

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